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Biofiltration Plant Located in a Citrus Grove at Covina, Calif.—See Article on Page 707

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DECEMBER 1941

TO OPEN NECHES RIVER TO OCEAN-GOING VESSELS

Among Our Writers

BERNARD L. WEINER (N.Y.U., B.S. in C.E. '22, C.E. '40) spent 8 years with the Westchester County Park Commission and 7 years with Madigan Hyland on design of bridges and skew arches. At present he is designing airports for the Air Depot Architect-Engineers.

ANTON TEDESKO (Institute of Technology, Vienna, Austria) formerly principal assistant to Professor Melan, has long been connected with the design of record-breaking wide-span steel and concrete bridge and building structures. Since 1932 he has been with the Roberts and Schaefer Company on concrete shell construction, and he is now manager of their Chicago office.

ARTHUR W. CONSOER (U. of Wis., '13) has been practicing as a consultant in the hydraulic and sanitary field since 1919. Before that he spent 2 years as a Captain of Engineers in the A.E.F., returning from France in command of the 126th Engineers.

C. FRANK JOHNSON (U. of Ky., B.S.C.E. '19, C.E. '38) had 8 years of municipal and sanitary engineering experience before going with the Commissioners of Sewerage of Louisville in 1930. At Louisville, his work has been on design and construction of sewerage and drainage works, including also the making of a study and report on the sewage-treatment problem in Louisville.

ROLF ELIASSEN (M.I.T., B.S., M.S., Sc.D.) started in sanitary engineering with the J. N. Chester Engineers of Pittsburgh. This was followed by 4 years in the West with the Dorr Co., on research, design, construction, and operation of treatment plants for water, sewage, and industrial wastes. In 1939 he taught at Armour Institute in Chicago and in 1940 he accepted his present position at New York University.

W. F. SWIGER (U. of Wash., B.S., '39; Harvard U., M.S. '40) following graduation remained at Harvard for several months doing research work in soil mechanics. He then entered the construction division of E. I. du Pont de Nemours and Co. Since November 1940 he has been employed as office engineer by R. V. Labarre, consulting engineer on foundations, of Los Angeles.

GEORGE L. HALL (Tufts College, B.S. in C.E. '11) has been engaged in sanitary engineering in Massachusetts, Ohio, and Maryland, and has had a wide experience in stream pollution problems, construction of sewage treatment plants, and garbage removal. He has been consultant to various municipal authorities on construction problems regarding water supply, sewage systems, and treatment plants, as well as on the sanitary aspects of water supply and sewage disposal.

EDWIN C. KELTON (Ohio State U.; U.S. Military Academy; Cornell U., E.E.; Army Engineer School; Army Industrial College; Army War College) has seen duty with the Corps of Engineers, U.S. Army, from 2nd lieutenant to colonel. In addition he saw active service in France with the 2nd and 6th Engineers and has had command of the 14th Engineers, Philippine Islands. At present he is district engineer, Los Angeles Engineer District.

K. A. REEDER (McGill U., B.Sc. '14) has been with the Southern California Edison Co. since 1919 as structural engineer engaged in the design of structures for power plants, substations, and transmission lines. Previously he was with Barnett and McQueen, Contractors, Fort William, Ontario, on the design of reinforced concrete grain elevators and mills.

T. C. BRUNS (U. of Va., '23; Tulane, B.E. and C.E. '27) has had heavy construction experience with Doulut and Ewin, Inc., in Louisiana, Texas, Tennessee, Kentucky, and Florida on roads, buildings, levees, bridges, and sea walls. In addition he has been engineer, superintendent, and estimator for the Raymond Concrete Pile Co. At present he is on active duty as lieutenant commander, Corps of Civil Engineers, U.S.N.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Engineers and World Economy

By Bernard L. Weiner, M. Am. Soc. C.E.
With Air Depot Architect-Engineers, New York, N.Y.

THE engineering profession in all its branches, and the scientists, have many truly great achievements to their credit; and, justly, they are proud of their accomplishments. But while they have made possible the physical basis of modern civilization, they have been content to permit others, self-styled experts, to take the lead in determining national policies as to how their inventions and improvements should be utilized. The result is world-wide chaos; and, for the second time in one generation, the repeated breakdown of the world economy has brought civilization to the brink of disaster which engineers might have prevented had they accepted a task for which they are peculiarly fitted. From the broad point of view, what else but bringing order out of chaos is an engineer's work?

Applying Engineering to Economics.~As a class, engineers are notoriously modest, and it has therefore not occurred to them that they might succeed where others have failed. They are apparently unaware that their special knowledge is not commonly shared by other groups, and that their method of approach to the solution of a problem is not universally known. But it is nevertheless not unreasonable to suppose that the same scientific methods that made possible the physical basis of modern civilization could also be used to further human happiness by making the necessities and even the luxuries of life available to all mankind. To accomplish this purpose, the engineer can take a leading part in establishing the guiding facts or criteria on a scientific basis.

It is not so much a question of the engineer's turning economist as it is of introducing engineering thinking and engineering methods into the field of economics. Research to establish the facts, and analysis to determine the basic principles and the solution from the facts, is the very basis of the engineering and scientific method. Economic thinking, too, can be checked against principles that are common to all sciences, in one form or another. The surveying principle of the closed traverse, which appears in physics as the law of conservation of energy, and many equally important engineering principles, are neither known nor understood by the layman—which explains why mutually exclusive measures will be advocated by supposedly intelligent people including business and industrial leaders and statesmen.

A classic example is the attempt to increase the export trade—and then preventing imports by setting up the highest tariff in American history. In economics as in any other science, certain factors can be assumed or predetermined; but once assumed, the remaining factors are beyond control—they must work out as they will and "refuse to be forced." There is no magic or fate about it any more than there is in the fact that two plus two always equal four. In general, when the fundamental criteria—not only of science but also of common sense—are not satisfied, the system, in whatever field it may be, must break down and stop.

Financial Fictions Confuse.~Furthermore, both the engineer and the scientist know that their descriptions and formulas are merely symbols of the underlying realities—which at best are pictured only approximately—and they are constantly on guard against drawing absurd conclusions from terms that have wandered too far from the realities they are supposed to represent. Much that is absurd in economic thought can be traced to the fact that thinkers on the subject have not been on guard against this very pitfall.

Thinking only in financial terms can give nothing more than an analogy or incomplete picture of the underlying industrial and engineering realities. And sooner or later, as is the nature of analogies, this one also breaks down. The absurdity of many an economic policy becomes apparent if it is translated from fictional financial terms into terms of actual reality.

Engineering Realities Remain.~Paradoxically, it is only for war—when the world goes mad—that it seems possible to organize the national economies on a sane basis—on the basis of "needs" and of plant capacity. Only then is it recognized that money is of secondary importance—the real power, the economic reality, is production. "Economic experts" seeing only the mystic symbol of the dollar sign, are already saying that the country must start preparing now for the inevitable letdown after the defense program is over—and no one, apparently, is questioning the assumption that there must be a letdown.

There is no physical reason why the productive capacity cannot be diverted from the social waste of war material to useful peace-time commodities. The housing

shortage, for instance, is of such magnitude that it would take thirty years of peace-time capacity production to overcome it; yet the financial myopia is such that the American people are told that the government cannot "afford" to finance the necessary housing, and that private industry cannot do so because it is unprofitable. But the engineering fact remains, nevertheless, that men and material have both been physically available, especially during the decade after 1929. In fact, the combined cost of an adequate housing program and of the defense program is only a fraction of the real wealth lost to the country forever by the idleness of both men and factories during this decade.

No Sincere Attempt at Solution.—The causes of the economic crises are, unfortunately, not physical; and since only the value of physical research has been recognized, the problem remains unsolved. Paradoxically, again, as the products of industry approach perfection as the result of physical research, the economic crises become ever more acute. One would imagine that an attempt to solve the non-physical problems by the same methods that were so successful in the physical field, would have been made long ago—but, instead, industry has resorted to ineffectual expedients. "Research" has been confined merely to such superficial studies as the charting of market trends. Modern advertising ballyhoo is just one example of the competition for the same consumer dollar in a market of more or less fixed capacity.

But if a small fraction of the annual quarter billion spent on physical research, or if a portion of the huge sum spent on advertising, were diverted to fundamental non-physical research in an effort to increase the effective capacity of the existing market, it is possible that intelligent cooperation for the common good would accomplish what senseless competition has failed to do. Such an investment might easily pay large dividends in dollars and cents—it staggers the imagination what such successful research would accomplish in terms of human happiness.

Increasing Unrest and Violence.—The present unrest has been given various labels—a common practice in times of stress. But by whatever "ism" it is called, it is all one and the same thing. It is all merely the expression of the pent-up desire that poverty in a world of potential plenty be eliminated. If engineers and scientists, aided by their societies in getting the backing of industry, do not use their scientific knowledge, and especially their technique, to solve the problem successfully, demagogues will offer remedies that will prove even more unsuccessful than those they have already used—and with even worse results. That the resulting explosions will tend to become more and more violent is inevitable.

In the era of economic scarcity before the Industrial Revolution, poverty was accepted as the unfortunate but inevitable lot of the majority of mankind. A spirit of resignation prevailed which tended to reduce the shock of the periodic explosions. But this psychology is rapidly disappearing with the universal realization that in spite of the fact that a new era of potential plenty has come, poverty still persists. The idea is therefore getting about that there is "a dog in the manger" somewhere—which explains the European debacle. To forestall similar results in this country, industry, guided by engineers and scientists, must take a leading part in solving the nation's and the world's economic problems. For its own benefit and protection, industry must organize a research staff to find ways and means to enable it, not only to operate its present plants at capacity, but also to expand—and for peace-time production.

Approach to a Solution.—Certain steps suggest themselves at once. That surveys of both the capacity to produce and of the capacity to consume must be made in order to provide accurate, basic data, is elementary. Every hypothesis, every concept, and every factor that even remotely affect the national economy must then be questioned and reexamined. Foremost among these is the money factor—fundamentally a simple tool—which has been so surrounded by mystery that it is constantly being confused with its prototype, real wealth in the form of the products of industry. Although the huge national debt, for example, is a source of real danger to the national economy, it is not true that this generation has saddled future generations, as a whole, with a necessary, real burden. Future wealth has not been mortgaged—only future dollars. The trick of how to eat, today, the loaf of bread that will not be baked until tomorrow, has yet to be discovered. Even the necessity of mortgaging future dollars can be seriously questioned.

Instead of first determining the realities in terms of the capacity to produce and to consume, and then adjusting the money tool to these needs in the same way that machines are designed to perform their functions according to the needs of an industrial process, the cart has been put before the horse and money permitted to determine these needs.

Disclosed by Non-Physical Research.—The apparent necessity to mortgage future dollars is one of the minor evils resulting from this practice. Money is an important tool—but only a tool—and its basis, concept, and meaning must therefore be reexamined and related to the realities.

Further steps to be taken and concepts to be questioned could be suggested if space permitted. It should be clear, however, that from the engineering point of view there is no reason why production cannot continue at least at the same pace as now—except that consumers' commodities will be produced. To make one prediction, when non-physical research shows the adjustments necessary to keep the economic system—and especially its financial tools—from jamming up, the world will be amazed by its present economic myopia. The simple, elementary, common-sense fact should be obvious that this country can "afford" whatever it is physically able to produce. If thinking in financial terms leads to the opposite—and absurd—conclusion, is it not obvious that there is something radically wrong with this kind of thinking?

Duty of Engineers and Scientists.—Since those who have been responsible for the functioning of the economic system have shown that they do not know how to do the job, the engineers and scientists who have demonstrated the efficiency of their technique will have to take over and find out how to finish the task. If this job is not started soon, it will be too late; or, at best, twenty-five years from now the country will be preparing for a third world war. If this happens, one may be sure that the scientific professions will have done their part efficiently, in the physical field—they will have invented and perfected bigger and better weapons for more efficient mass murder and destruction of wealth.

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NUMBER 12

Wide-Span Hangars for the U.S. Navy

Bureau of Yards and Docks Builds Huge Reinforced Concrete Structures of Unique Design

By ANTON TEDESKO, M. AM. SOC. C.E.

ENGINEER-IN-CHARGE, STRUCTURAL DEPARTMENT, ROBERTS AND SCHAEFER COMPANY, CHICAGO, ILL.

AMONG the largest reinforced concrete structures of their type ever constructed are the recently completed hangars of the Bureau of Yards and Docks, U.S. Navy. In addition to mere size they are unique in structural details, such as the hinges, the foundations, and the pre-stressed tension ties. They also are an outstanding example of the advantages of adjusting the design to make the form work more economical and to save time and money in construction. The resulting monumental structures are things of beauty, economically serving the purposes for which they were built. In this paper Mr. Tedesko gives a review of the prominent features of this work.

COMPARISONS between types of design and materials of construction led the U.S. Bureau of Yards and Docks to adopt for its new hangars a monolithic concrete arch design, the shape of which is influenced by economic considerations and by a carefully planned construction procedure.

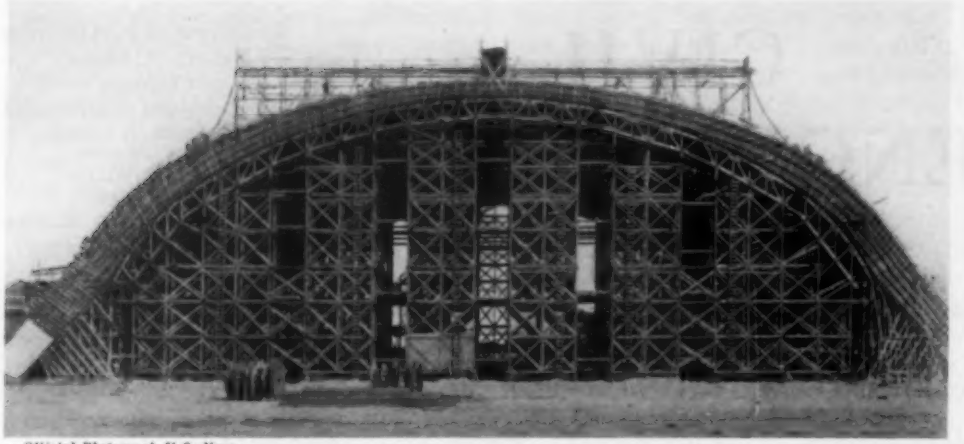
The Navy's requirements called for a building consisting of two adjacent hangars with door openings at both ends of each hangar. The space along the outside of the building was to be used for offices, and the space between the double hangars for shops or offices as desired. This led to an arrangement of arch barrel hangars in double formation, each of which is made up of four structurally independent units, so that one set of forms can be used for all units. The main concrete arches of the hangar are arranged so that the concrete roof slab is supported from the intrados of the arches with no structural members projecting below the smoothly curved under side of the roof. This permits the moving of the forms (which are mounted on a traveler arch centering) from one unit to the next without reconstruction as would be necessary if the arches were projecting below the under side of the roof shell. After each roof pouring cycle, it is necessary only to lower the forms a few inches before rolling the centering ahead into the next position.

The barrel shell roof, built on the principle of three-dimensional design, is the most important part of the structure, not only on account of its unusual size and span, but also because of the time element involved in its economical construction. Considerations of shell design and re-use of forms were the deciding factors establishing the length of roof units and the location of expansion joints. These joints act not only to reduce the temperature stresses in the roof slab but also to eliminate the hazards of unequal settlements. Like the upper portion of a pipe of great section modulus and rigidity, the concrete shell roof spans between two arches and bridges beyond the arch to an expansion joint. Each unit between expansion joints is structurally independent of the other units.

Soil conditions and earthquake considerations determined the character of the main structural system, namely, concrete arches of the two-hinged type tied below the floor. Their shape is governed by the lines of thrust under different loadings, by door clearance requirements, and by the cross-sectional curve of the roof. This curve is determined by strength and buckling requirements for the thin cylindrical roof shell, which spans between arches and which, for sufficient carrying power, must not have too great a radius in the crown. To facilitate convenient construction, the roof shell was made not too steep at the springing line. The two-hinged arches take vertical and horizontal loading in the usual manner.

Official Photograph U.S. Navy

OBLIQUE VIEW OF FINISHED AND SEMI-FINISHED SHELLS
Shows Rib Arrangement and Monolithic Lean-to Structure



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MOVABLE ARCH CENTERING INCLUDES TOWERS, TRUSSES, AND FORMS
Progress Photograph of One of the Hangars. Note Trestle on Crown, which Carries Concrete Pump Line

The roof shell of each unit is rigidly framed into two arches and into the lean-to roof. These elements, together with the lean-to walls, form a box-like structure resting on four inclined arch legs. Lateral forces at right angles to the arch are transferred by the box structure to its legs, which by frame action transmit the forces to the ground. The arch haunches are hinged at floor level (fixing the line of pressure at definite points) so that rotations in the plane of the arch may easily take place. At the same time they are restrained laterally by the lean-to structure, by the general rigidity of the shell, by the footings, by earth pressure, and by the pile foundations, with the result that forces perpendicular to the plane of the arch which tend to overturn the structure are effectively counteracted.

Bridge-type bearings for arches are costly and would have delayed the start of construction. Therefore a concrete section was combined with hinges of the Mesnager type, towards the development of which in this country Admiral Ben Moreell, M. Am. Soc. C.E., (C.E.C.) U.S.N. has outstandingly contributed. These hinges were constructed of reinforcing bars which transfer the load from the arch haunch to the footing. The bars are arranged in a fan-like system which permits rotation of the arch at the hinge. The hinges of the standard arch are 80 in. long and are composed of thirty-two $1\frac{1}{4}$-in. round vertical bars which take the vertical reactions, the horizontal components being resisted by twenty 1-in. diameter bars in fan-like arrangement. The bars are not larger than $1\frac{1}{4}$ in. in diameter to more easily take the bending stresses due to rotation.

TAKING CARE OF OVERTURNING MOMENTS

Overturning moments which become great because of earthquake forces are resisted by special high-yield-point bars placed at each end of the hinge axis. These bars were used because of the impracticability of providing a sufficient number of new billet steel bars of intermediate grade at the extreme fibers of the hinge. High-strength heat-treated steel was used for the special bars near the extreme fibers, the minimum yield point being 70,000 lb per sq in. The adjoining bars of intermediate grade, which under earthquake shocks may reach their yield-point stress, cannot deform more than the high-strength bars will permit. The reaching of the yield-point stress of the intermediate-grade hinge bars is, therefore, not critical for the strength of the section. The high-strength steel bars near the extreme fibers of this bending section protect their weaker companions of intermediate grade, so that the same safety and service value are obtained as if the hinge bars were of high-strength steel throughout. With an increase of 15% in the total price of the hinge steel, the overturning resistance of the arch was almost doubled.

Footings were constructed on wooden piles and were tied together by individual tension ties in such a manner that the horizontal thrust could be taken up as it developed during the decentering operation. The arches are not quite symmetrical because the twin-arch arrangement makes use of a combined center pier to carry the arches from both hangars. Each hangar is designed, however, for separate stability in case of damage to the arches of the other hangar. As a result of this design, the tension ties at the center pier are arranged below the hinges, while the ties are connected above the hinge at the exterior arch haunches. As a further result, the center pier takes the full inclined arch reactions while the exterior piers take only the vertical component of the arch reaction (550 tons).

While $2\frac{1}{2}$-in. round steel rods originally were planned for the individual tension ties, they were replaced later, with a saving in cost, by second-hand high-strength cables previously used in bridge construction. The cables (eight $1\frac{1}{16}$-in. bridge strands to each main arch) were pre-stressed during the decentering operation of the arch. As load was taken off the centering by the lowering of form jacks, and as load was carried by the arch itself in increasing measure, the tension ties, arranged in trenches, were adjusted to take the accumulating horizontal thrust in order to prevent the footings from moving outward. As thrust developed, each cable, of 1.46-sq in. cross-section, was stressed by a pull of approximately 39 tons actuated by press arrangement outside the footing structure. The corresponding stretch of $7\frac{1}{2}$ in. was taken up by the tightening of nuts at the ends of the individual tension ties. The thrust due to dead load is thus taken up by the ties, so that under dead load each footing receives a vertical reaction only.

Main arches increase in depth and width towards the springing line of the roof. Moments, shears, and axial forces were calculated separately for the arch and shell dead load, symmetrical and unsymmetrical live loads, including seven 20-ton hoist loads per arch, as well as for wind loads, temperature and shrinkage, earthquake loads, and movements and deformations (such as rib shortening). The measured deflection of the arch during decentering was observed to be $\frac{1}{8}$ in. less than the calculated deflection of $\frac{5}{8}$ in. The vertical deformation of the shoring during pouring of the concrete was about $\frac{1}{8}$ in. Wherever the tension condition in the extrados of the arch made inadvisable the use of splices by overlapping, $1\frac{1}{2}$-in. plain round reinforcing rods of the arches were spliced by means of threaded sleeves, achieving an unyielding connection when set under initial stress.

The end arches of the structure take a large share of the forces due to wind on the doors and on the window area

above the doors. To prevent excessive moment concentrations in the roof shell under wind load at points where the structural members of the curtain wall above the hangar door are restrained into the roof, the design of the end arch required a section of considerable torsional resistance to distribute these moments. Two individual door arches, connected in their upper portion by cross struts, provided a torsion section that was practical from a construction standpoint. In their lower portion, where torsion requirements are low, they were constructed as individual arches a clear distance of 5 ft 4 in. apart, which is the space necessary to accommodate the rolling doors in their open position. The doors, made up of ten leaves, are arranged on five tracks. Each pair of door arches is supported by one set of footings.

The curved roof shell not only carries its own load but acts as lateral bracing for the arches; it consists of a slab $3^1/_2$ in. thick in the crown portion, increasing in thickness and curvature towards the springing line. The roof shell is stiffened by auxiliary ribs 10 by 20 in. at mid points between arches, with two such ribs at expansion joints. Over its major portion the shell is subject to a condition in which the direct stresses within are in equilibrium with the surface loads. A flexural condition exists where the shell is restrained by heavier structural members, such as the main arches, and in these areas its thickness is increased to $4^1/_2$ and $5^1/_2$ in. Since the stresses are rather low and the minimum sections are governed by buckling requirements, the shell may be expected, in case of bomb damage, to carry out (by transfer and redistribution of stress) functions for which it is not ordinarily designed and thereby to take over important structural action which may help localize damage. Because it is statically indeterminate and rather evenly reinforced, the shell has a carrying reserve usable in emergencies.

In the flatly curved crown region, the shell is unable to resist the torsional rotation of the door arches, a condition which causes one door arch to move upward slightly, the other to move downward. However, as the shell becomes steeper and its curvature sharper away from the crown, it provides greater resistance to the forces tending to twist the arch out of its vertical plane. The curved roof slab as a whole is stiff enough to transfer reactions from the door front to the next main arch, so that all arches of one roof unit participate in the transfer of lateral forces to the footings.

The shell, which is stiff in all directions of its tangential plane, is rather steep where it connects with the lean-to roof. Its action, therefore, is similar to that of a high wall on closely spaced supports, which is highly capable of carrying vertical loads. The depth of the shell cylinder engaged in this carrying action is about 40 ft. The shell would deflect less under vertical loads than the shallow lean-to roof if the latter were not held by the stiffer shell. The lean-to roof, therefore, hangs from the shell. This means that the shell stresses in the arch direction near the springing line are tensile and not compressive. What usually is termed an arch thrust does not exist at these points; in its place a tension condition has been set up.

As in the case of a high wall, the construction height of a shell often cannot be fully utilized structurally. It is economical for a shell, from the standpoint of its stress distribution, to carry its loads by means of direct stresses. The work of deformation produced by even a high direct stress (as may be due to a construction height which is restricted or not fully utilized) is still usually relatively small compared to the work of deformation if a bending condition should be prevalent (least work of deformation is what nature desires). In the longitudinal action of the shell spanning between supports, the lever arm of internal forces (longitudinal stresses) depends only on the radius and the span of the given shell. If the height of the construction is decreased by omitting parts of the shell, by providing skylights, and so forth, the direct stresses do not necessarily increase; or if the span of the construction is increased (as, for instance, by damage to a support), the lever arm of forces will increase, instead of the direct stresses, which is a safety feature in shell design of considerable value for a military objective.

After construction of the footings and the hinges, the arch haunches were poured up to the springing line of the roof. During this operation the haunches were kept locked to prevent rotation and excessive deformation of the hinge bars.

CENTERING FOR THE ARCHES

The traveler centering consisted of a system of tower units built of 6 by 6-in. wooden posts on 10-ft centers, braced horizontally and diagonally. On top of the scaffolding towers, screw jacks were provided to support wooden trusses about 30 ft long, built with the use of split-ring timber connectors. The top chords of the trusses were cut to the curvature of the roof and carried 2 by 10-in. joists on which sheets of $^5/_8$-in. plywood forms were placed. The screw jacks between posts and trusses permitted adjustment of forms as to correct elevation and

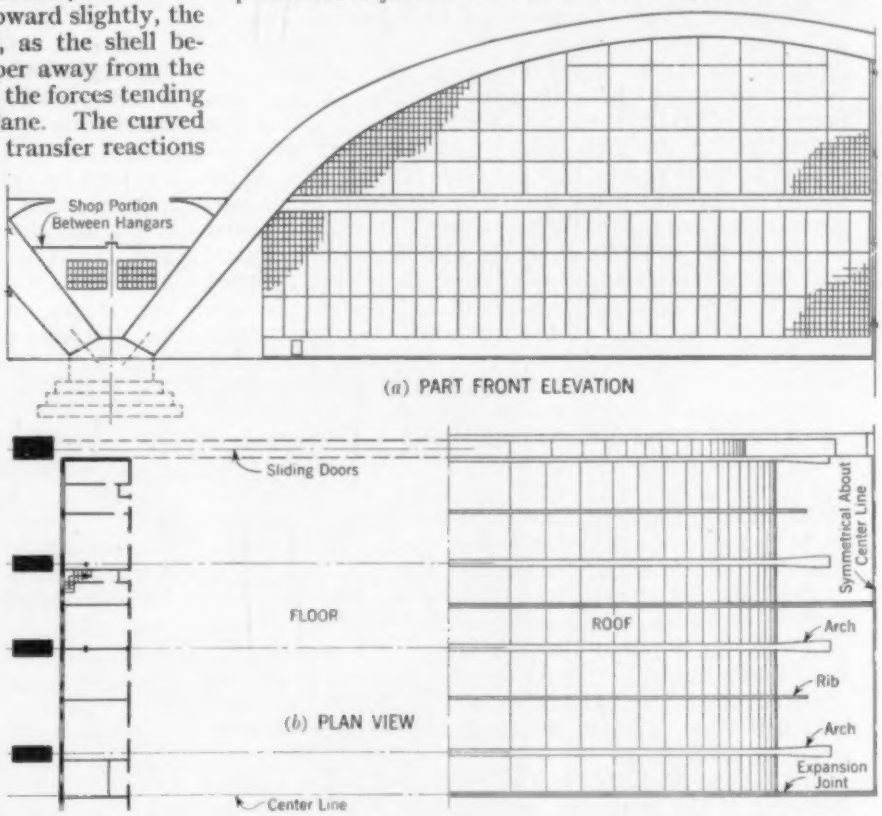
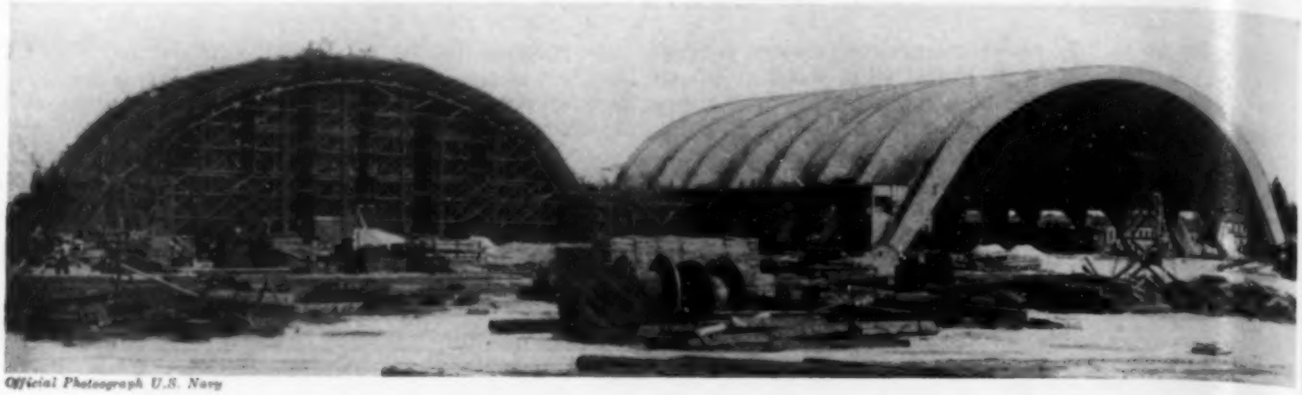


FIG. 1. SKETCHES OF HANGAR: (a) RIGHT-HAND BAY FROM FRONT, AND (b) LEFT-HAND BAY FROM ABOVE, SHOWING ROOF AND FLOOR. VIEWS NOT IN LINE AND NOT TO SAME SCALE



Official Photograph U.S. Navy

TWIN HANGARS UNDER CONSTRUCTION

made possible a smooth decentering. The arch centering, covering the plan area of one roof unit between expansion joints, was moved in four sections. It was pulled by a caterpillar tractor from one position to the other with the use of pipe rollers 4 in. in diameter on 6 by 12-in. sills, which were blocked up to a horizontal level. The transverse movement of the centering from one hangar to the location of the twin hangar was accomplished by skidding the centering sidewise on old rails available at the site.

Reinforcing for the shell consisted of straight $^{3}/_{8}$-in. and $^{1}/_{2}$-in. round bars at right angles to each other, with additional diagonal layers of $^{1}/_{2}$-in. and $^{5}/_{8}$-in. bars arranged where necessary in the lower portions of the shell in the direction of principal tensile stresses, the concrete taking care of compressive stresses. The diagonal reinforcing bars carry the dead and live loads of the shell back to the arches and in their arrangement are suggestive of the shape or direction of cables of a suspension bridge.

Two paving mixers discharged into the pump, of 60-cu yd hourly capacity, a 3,500-lb (strength) concrete mix, containing $6^{1}/_{2}$ bags of cement and aggregate not over $^{3}/_{4}$ in. in size. Two 8-in. pipe lines were run from the double pump to the crown of the roof, to a point midway between two arches where the pipes branched off, and supported by a trestle, extended about 80 ft each side of the center line of the arch span. Small hoppers were installed at these points, and the concrete was handled by means of elephant-trunk chutes to the points of placing. Boxes at horizontal distances of about 20 ft were arranged to collect the concrete from the elephant-trunk chutes, and the concrete was shoveled from these onto the roof shell, thus avoiding segregation of aggregates. In this way concreting of the roof unit proceeded symmetrically from both sides simultaneously. At times concreting was concentrated on one side while the pumping line was shortened and the boxes were moved up on the other side of the arch. Top forms for the roof slab arranged in small panels were necessary for a distance of 20 ft above the springing line of the shell on account of the use of a rather plastic concrete mix of $3^{1}/_{2}$-in. slump. The concrete pumping equipment available to the contractor influenced the consistency of the concrete.

The concrete of each roof unit was poured in a continuous operation, which at an average rate of 40 to 45 cu yd per hr required about 15 hours. When the concrete had attained a strength of 2,500 lb per sq in. and an apparent modulus of elasticity of 2,500,000 lb per sq in. (the deflection of beam specimens of the shell concrete being a measure of its safety against buckling), decentering was permitted and accomplished by the gradual lowering of the centering screw jacks. During the decentering operations, which required about one day, the deflections of the arch, the stretch of the tension ties, and the movements of the footings were carefully controlled. It was possible to obtain the desired concrete characteristics to permit decentering in from 5 to 7 days after placement of the concrete. This factor in turn controlled the cycle of other operations, so that a main roof pour could be made every two and one-half to three weeks.

The roof slab received a wood float finish. Expansion joints between the roof units are covered by sliding copper flashing. While the lean-to roof slab was concreted a day in advance of the main roof slab with which it is intimately connected, the second floor of the lean-to and intermediate columns of the lean-to structure were built after the arches had taken their dead-load deformation. The lean-to structure is divided into independent units in the same manner as the main structure. Flexible connections between the lean-to and the arches allow for differential settlements. Skylights were not considered necessary for the hangars, as the glass area in the curtain walls above the doors provided sufficient illumination.

DRAINAGE TRENCHES FOR FIRE PROTECTION

The 6-in.-thick hangar floor is traversed by a system of drainage trenches covered by galvanized grating. These trenches are designed to quickly carry off all gasoline and water from the sprinkler system so that burning gasoline cannot float to adjoining areas. A fire will be further localized by drains provided at points where trenches are lowered under tension ties of arches.

The hangars were constructed for the Bureau of Yards and Docks under the direction of Rear Admiral Ben Moreell (C.E.C.) U.S.N., Chief of the Bureau of Yards and Docks, and Captain Edward L. Marshall (C.E.C.) U.S.N., head of the Aviation Facilities Division. Captain J. T. Mathews (C.E.C.) U.S.N., was Officer-in-Charge, and Lt. Commander H. A. Bolles (C.E.C.) U.S.N., was the Resident Officer-in-Charge. Roberts and Schaefer Company of Chicago and Washington, D.C., were the designing and supervising engineers (Erskine W. Klyce, Jun. Am. Soc. C.E., resident engineer). Joe H. Lapish was the associated architect. The roof structure of "Z-D" design, as employed in the construction of these hangars, is under license from the Structural Shell Designers, Inc., of Chicago. The contract was ably executed on a cost-plus-fixed-fee basis by the Golden and Trepte Construction Company, contractors; S. F. Nielsen was their project manager, and J. M. Tomlinson, the superintendent. The cost and speed of construction of the completed hangars compare favorably with those of structural steel hangars of standard Navy design, having less than half the span of the structure described here, built by the same contractors on the same site.

Use of Ozone for Water Purification

Powerful Bactericide and Oxidizer Is Having Wider Application in This Country for Removal of Odors, Tastes, and Color

By Arthur Wardel Consoer, M. Am. Soc. C.E.

President and General Manager, Consoer, Townsend and Quinlan, Consulting Engineers, Chicago, Ill.

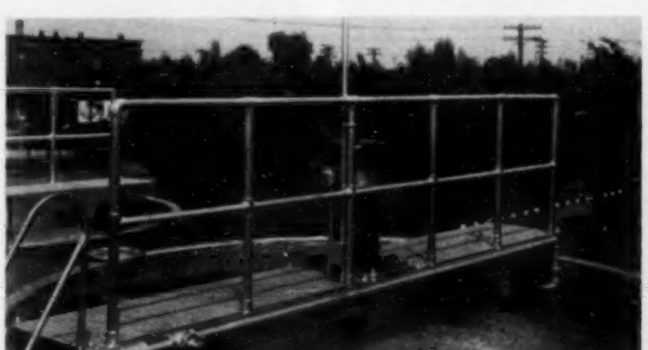
In line with the universal interest in municipal expenditures, people in general want to know how their taxes are being spent and what results are being obtained. In the case of water supply the taxpayer demands not only that his health be protected but also that the water be free from objectionable odors, tastes, and color. The ozone method of purification accomplishes all these at a reasonable cost as a result of recent improvements in the ozone manufacturing process. This paper was originally presented by Mr. Consoer before the Sanitary Engineering Division at the Society's Fall Meeting in Chicago.

American engineers engaged in water purification work have seemingly been slow to study the development of the use of ozone in France, Germany, Russia, and other European countries. In general we have not been eager to work out a suitable technique for using this purifier to supplement other means of treatment. This is rather surprising in view of the fact that since the discovery of ozone (O_3) in 1785, technical literature, both abroad and at home, has contained much discussion of its potent qualities as a bactericide and oxidizer. In parallel fashion, the design of equipment for manufacturing ozone and the development of ways and means for introducing it into water have lagged in the United States.

At a time like the present the construction of new water supply plants is more or less at a standstill, except for defense projects, which are almost certain to follow conventional patterns. The present is, however, a good time to review the interesting ozone process for possible application in the post-defense period.

OZONIZATION NOT A NEW PROCESS

Ozonizing of water for sterilization and for reducing objectionable tastes, colors, and odors, has been an acceptable method of treatment for several decades in France and other parts of Europe. In the United States it has had relatively few applications in municipal water plants. However, it has been used frequently to sterilize water on steamships and for the protection of the products of bottling plants, also for institutional water supplies. Such uses and a small number of successful municipal plants have served to establish ozone in this country as a practical means of sterilizing certain waters and for reducing taste, color, and odor.



Ozone Bubbles Removing Impurities from Water
One of the Ozonizing Tanks at the Whiting, Ill., Plant

Two of the earliest municipal ozonizing plants in the United States are those at Long Beach and Hobart, both in Indiana. At the former, water is drawn from a shallow intake in Lake Michigan located only 300 ft from the shore line and not far removed from the outfall of the primary sewage treatment plant of that community. The water purification plant, which treats unfiltered lake water, has produced a satisfactory finished water for the past ten years. At Hobart, Ind., raw water is taken from Deep River, a sluggish, swampy stream, laden with organic pollution of various kinds. This raw supply is treated in a conventional rapid sand filtration plant, and ozone is used to get better sterilization and as a beneficial auxiliary to reduce tastes, color, and odors. Here, too, water acceptable to the consumers has been produced since 1932.

Recently the cities of Denver, Pa., and Whiting, Ind., have installed ozonizing plants to bring about reductions in objectionable tastes, colors, and odors. The operating results at these places indicate the suitability of the ozone process where palatability as well as potability is desired.

Early equipment used in the United States for producing ozone was relatively extravagant in its use of electrical energy. This fact, coupled with higher rates for electric power than prevail today, undoubtedly discouraged the development of the process in this country. More efficient equipment for manufacturing and applying the gas is now available; this fact along with lowered rates for electric power promises a much extended use of this type of treatment.

Fashions change in water supply as well as in other matters of human concern. Many communities are no longer acquiescent about supplies that are below par from the standpoint of palatability. With the ozone process emerging from over a century of dilatory development, it may now be an important factor in the expansion, or improvement, of modern water supplies. In many cases it will deserve consideration on a practical and economic basis as a primary, and perhaps the sole method of treatment, and not merely as a desirable adjunct to present recognized processes. For such use, further experimentation will be necessary. This can be done by installing pilot plants. At Whiting, Ind., such a plant was recently installed be-

fore the building of a full-sized plant was attempted. Such studies and test procedures might well be carried out now in many localities to pave the way for later full-scale installations in the postwar period, when the construction of worthwhile public improvements will again become feasible and popular. Too many water purification plants, in the writer's judgment, have been constructed in the past without adequate preliminary studies and cost analyses of alternative types of treatment.

Ozone (O_3) is activated oxygen which contains three atoms of oxygen per molecule, as compared with normal atmospheric oxygen (O_2), which has but two atoms per molecule. This more active form of oxygen naturally produces an increased oxidizing effect when properly introduced into water burdened with organic matter. Ozone well diffused through the water can be expected to be extremely potent and well-nigh instantaneous in its action. The ozone is unstable as soon as released. One of the atoms tends to fly off, leaving behind the stable form of oxygen. Thus the ozone is quick to attack oxidizable organic and mineral matter. In the ozone process of water treatment, ozonized air bleaches and sterilizes the water by oxidizing matter held in solution or in colloidal suspension. In other words, the ozone is used to directly destroy pathogenic bacteria and the organic matter on which they live. Ozone will also destroy certain organic material responsible for tastes, colors, and odors. The chemical reactions involved are readily ascertainable.

INTERIOR VIEW OF WHITING (ILL.) PLANT, WITH OZONE PRESSURE STORAGE TANK IN FOREGROUND

MANUFACTURE OF OZONE

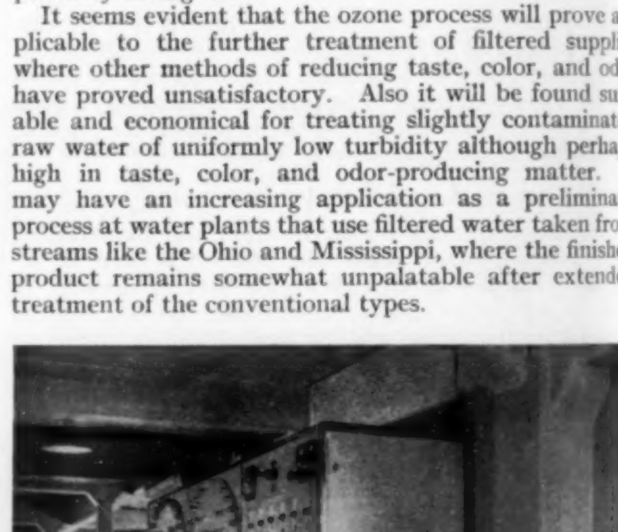
Ozone is produced commercially by first conditioning an air supply by cleaning and drying. The air is then passed under pressure through the arc or corona produced between a series of dielectric plates or electrodes by the discharge of an alternating current of high potential. From such air "ozonators," the ozonized air is carried to large mixing tanks or "ozonizers," where it is introduced into and diffused through the water to be treated. The ozonized air rises in these vertical tanks in myriads of bubbles, so as to contact the organic matter in solution or suspension. The detention period in the ozonizers is usually from 4 to 10 minutes. Where ozonizing is combined with filtration, the application of ozone precedes coagulation, settling, and filtration.

The design and skillful assembly of mechanical units and structures for conditioning and compressing air, generating ozone, and diffusing it in the water, present challenging problems to sanitarians and hydraulic engineers. The ozone process should not be allowed to follow the early path of rapid sand filtration and become solely a matter of sales promotion work. Right now, when this novel method seems about to enjoy more extensive use, it should receive attention from engineers in the water supply field. The process should be examined and tested thoroughly, and used in harmony with the best traditions of the sanitary engineering art.

To this end, design and operating data on new ozone plants should be made quickly available to all in the water treatment field. Information on construction and operating costs will be most beneficial initially. At Whiting, Ind., it was found possible to add the ozone process to an existing 4-mgd rapid sand filtration plant for approximately $30,000. A nominal ozone-generating capacity of 50 lb per day was provided. There the average ozone dosage has been 11.7 lb per million gallons, and the maximum, 43 lb. With electric energy at $0.0123 per kw and fuel gas at $0.11 per therm, the additional cost of chemicals at Whiting for ozonizing the water amounted to $1.99 per million gallons. This figure takes into account reductions in the cost of alum, chlorine, and ammonia after the introduction of the ozone process. The total additional annual cost of ozonizing the water, including $1,800 for fixed charges and $409 for maintenance (but no increase in cost of operating labor), is about $4,000, or $4.44 per million gallons.

Fortunately at Whiting the maximum ozone demand does not occur simultaneously with the maximum water demand. Where it does, the unit cost of the process will probably be higher.

It seems evident that the ozone process will prove applicable to the further treatment of filtered supplies where other methods of reducing taste, color, and odor have proved unsatisfactory. Also it will be found suitable and economical for treating slightly contaminated raw water of uniformly low turbidity although perhaps high in taste, color, and odor-producing matter. It may have an increasing application as a preliminary process at water plants that use filtered water taken from streams like the Ohio and Mississippi, where the finished product remains somewhat unpalatable after extended treatment of the conventional types.



OZONATORS FOR MANUFACTURING OZONE AT WHITING (ILL.) PLANT

Performance Tests of Large Pumping Plant

Two Years of Trouble-Free Operation Prove Value of Rigid Testing Program for Equipment in Louisville (Ky.) Sewage Pumping Station

By C. Frank Johnson, Assoc. M. Am. Soc. C.E.
Senior Engineer, Commissioners of Sewerage of Louisville, Ky.

Automatic pump operation has reached a high peak when a station with a capacity of 56,000 gal per min can be operated for two years with no attendant—only weekly maintenance calls. This operation schedule was made possible by the rigid series of tests to which the pumps were subjected before their acceptance. What these tests were, how they were conducted, and the difficulties which they made it possible to forestall, are here described by Mr. Johnson, the man in charge of putting in the equipment and conducting the tests.

Pumps and other equipment of The Point Sewage Pumping Station recently completed in Louisville, Ky., were subjected to extensive performance tests before their acceptance. These tests were deemed advisable primarily because the operation of the station was planned to be entirely automatic. With only weekly maintenance calls, it was desired to turn the station over to the municipal maintenance department with the fullest assurance that the equipment would perform as intended.

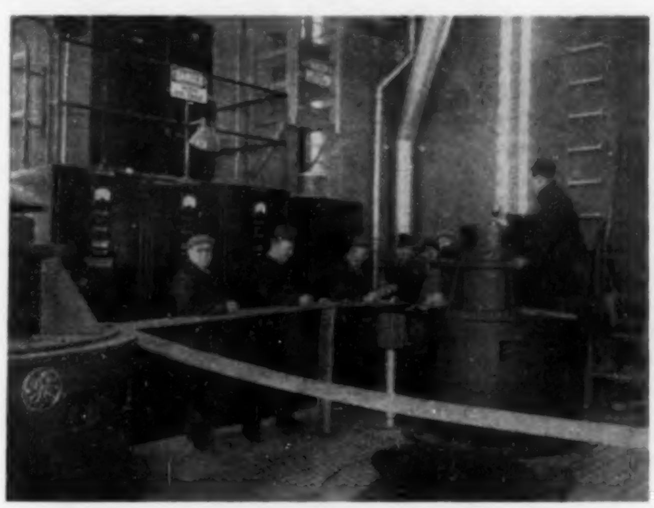
A description of the pumping installation must necessarily precede a description of the tests. The station contains 4 pumps—48 in., 36 in., 16 in., and 3 in. in suction and discharge nozzle diameters, with provision for a future 16-in. pump. The 48-in. and 36-in. pumps are for storm water but also handle sewage mixed with the storm water, while the 16-in. pump handles the dry-weather flow of sewage, with a limited amount of storm water. The 3-in. pump is a sump pump, for drainage within the pump house. All the pumps are single-stage, vertical-shaft, volute type. The 48-in. and 36-in. ones are of mixed-flow type, with combined axial and radial flow, operating at 195 and 320 rpm, respectively, and the 16-in. and 3-in. pumps are centrifugal pumps, with closed impellers, operating at 385 and 1,155 rpm.

The pumps are direct connected to 300, 250, 30, and 5-hp motors, respectively. The operating current is 440 v, 3 phase, 60 cycle. The 300-hp and 250-hp motors are of the wound-rotor type, provided with starting resistors for five starting steps, and the 30-hp and 5-hp motors are of the squirrel-cage type, having across-the-line starters. Each motor is protected by a thermal overload relay with automatic reset. In addition, each motor and its branch circuit is protected by a hand-reset circuit breaker, set to trip on higher overloads than the thermal overload relay and having instantaneous protection against short circuits.

Except for the 3-in. pump, which is a wet-well unit operating in a sump, the pumps are installed in a dry well on the lowest floor of the pump house. The motors are on a floor 50 ft above the pump floor. As shown on Figs. 1 and 2, the storm-water pumps (48-in. and 36-in.) take their suction from a well extending underneath the pump floor. They discharge into a conduit which has its outlet in Beargrass Creek a short distance from the Ohio River. The arrangement of the suction and discharge of the 16-in. pump is somewhat different in detail from that of the larger pumps; the principal difference is that the discharge is into a sanitary trunk sewer instead of into the creek. In the discharge line of each pump, except the 3-in., there is an automatic cone valve, which acts as a check valve and also as a gate or shut-off valve when desired. The cone valve remains closed except when the pump is running, being opened automatically when the pump is up to speed and closed automatically when the current goes off the motor. The cone valve is operated by city-water pressure controlled by a solenoid-operated valve. Starting and stopping of the pumps is controlled automatically by floats and float switches, but provision is made at the switchboard for manual control when desired.

The elevation at which the pumps were set was controlled by the existing low-level sewer at the site, from which the sewage and storm water are pumped. The pumps were set so as to be below the minimum sewage level and therefore always primed. The setting of the motors on a floor 50 ft above the pump floor was dictated by the desirability of placing them at an elevation above what was considered to be "high water" in the Ohio River. However, the unprecedented 1937 flood, which occurred during the construction of the station, went to an elevation 9 ft above that of the motor floor. This necessitated providing watertight doors for the superstructure of the pump house and making other like revisions, although it is expected that floods higher than the motor-floor elevation will occur only once very 50 years on the average.

In designing the station, it was desired to provide storm-water pumping capacity ranging from 56,000 gal per min at a 15.3-ft head to 5,000 gal per min at a 34.1-ft head. Since it was impracticable to provide this wide range with one pump, it was necessary to have two. It worked out best to provide one pump (the 48-in.) to handle the larger quantities at the lower heads, and the other (the 36-in.) to handle the smaller quantities at the



Observers, Recorders, and Other Personnel Gathered in Motor Room to Witness Head-Capacity Test of 36-In. Pump

higher heads. The main advantage of this plan was the reduction in the monthly electric bill, which in most months consists of the minimum bill or "demand" charge based solely on the connected horsepower. Under the plan adopted, this is only that of the 300-hp motor plus that of the 5-hp motor. In order to attain this, it was necessary to make the unusual requirement that it should be impossible to operate any two of the main pumps (48-in., 36-in., and 16-in.) at the same time.

The weight of each motor rotor, pump impeller, and intermediate shafting, plus the load due to operating thrust, is carried by an oil-lubricated, ball thrust bearing located at the top of the motor. At the bottom of the motor is a sleeve steady bearing. Each of these motor bearings operates in a reservoir of oil. One steady bearing for the shafting is provided at each of the 48-in. and 36-in. pumps, constructed integrally with the pump, while two similar steady bearings are provided at the 16-in. pump. Intermediate guide or steady bearings for the shafting are provided at about 10-ft intervals. Pump and shaft steady bearings of the 48-in. and 36-in. pump units are babbitted sleeve bearings, operating in a reservoir of oil, while the corresponding bearings of the 16-in. pump unit are ball bearings, lubricated by a circulating-oil supply. An oil pump at the main pump floor forces this oil to a storage tank located above the motor floor, whence it flows through sight-feed oilers to the bearings and back to the oil pump by gravity.

As previously stated, after installation of the equipment in the pump house, a rigid set of tests was prescribed before its acceptance. This program was divided into twelve main tests, as follows:

1. Each pump and its suction and discharge piping were subjected to an internal hydrostatic pressure of 65 lb per sq in. All joints were made watertight under this pressure.

2. Each pump was operated separately and continuously for 24 hours to determine its general fitness. Thermometers were attached, by putty and friction tape, to the outside of the housing of each bearing as well as to the motor stator, and the temperatures were read every hour during the run. At the thrust bearing the temperature of the oil was taken. No excessive overheating developed. Records were kept of other observations made during the run, such as air temperatures, motor speeds, ammeter and voltmeter readings, suction and discharge heads, oil, grease and water leakage, if any, and so on. During this run the head pumped against was varied by throttling the cone valve (or, for the 3-in. pump, the gate valve) in the discharge line in several positions between fully open and completely closed. The valve was fully open for about 12 hours of the run, then throttled to three-quarters open for 4 hours, then to one-half open for 4 hours, then to one-quarter open for a short time varying from 2 to 4 hours depending on conditions, and then completely closed for one-half hour. The 48-in. and 36-in. pumps ran somewhat roughly and noisily when the valve was only one-quarter open, owing to hydraulic disturbances caused by the small amount of water being pumped. For this reason these pumps were operated for only 2 hours under this condition. The 16-in. and 3-in. pumps ran very smoothly with the valve only one-quarter open, so they were operated for 4 and 3 hours, respectively, under this condition.

Prior to the operation of any pump with the discharge valve completely closed, there was some fear expressed that the water in the pump casing might heat up excessively and also that the pump might operate so roughly that this part of the test could continue for only a few moments. However, during the operation at "shut-off" for a half hour, no increase in the temperature of the pump casings was observed, nor was the operation of any pump excessively rough. The 16-in. and 3-in. pumps ran smoothly, but the 48-in. and 36-in. pumps ran somewhat roughly. Operation at shut-off could have continued longer but it was decided that this was unnecessary.

During the 24-hour runs the thermal overload relay coils originally provided for the 300-hp and 5-hp motors proved to be too light, as they tripped out and had to be replaced by heavier coils before satisfactory tests could be made.

3. Each pump was started, and then permitted to stop, 50 times in succession at 1-min intervals, by manual operation of its float switch. After the float switch was closed, it was held in the closed position until a few seconds after the cone valve was fully open, the pump having attained full speed prior to this time. Then the float switch was opened and the pump permitted to coast

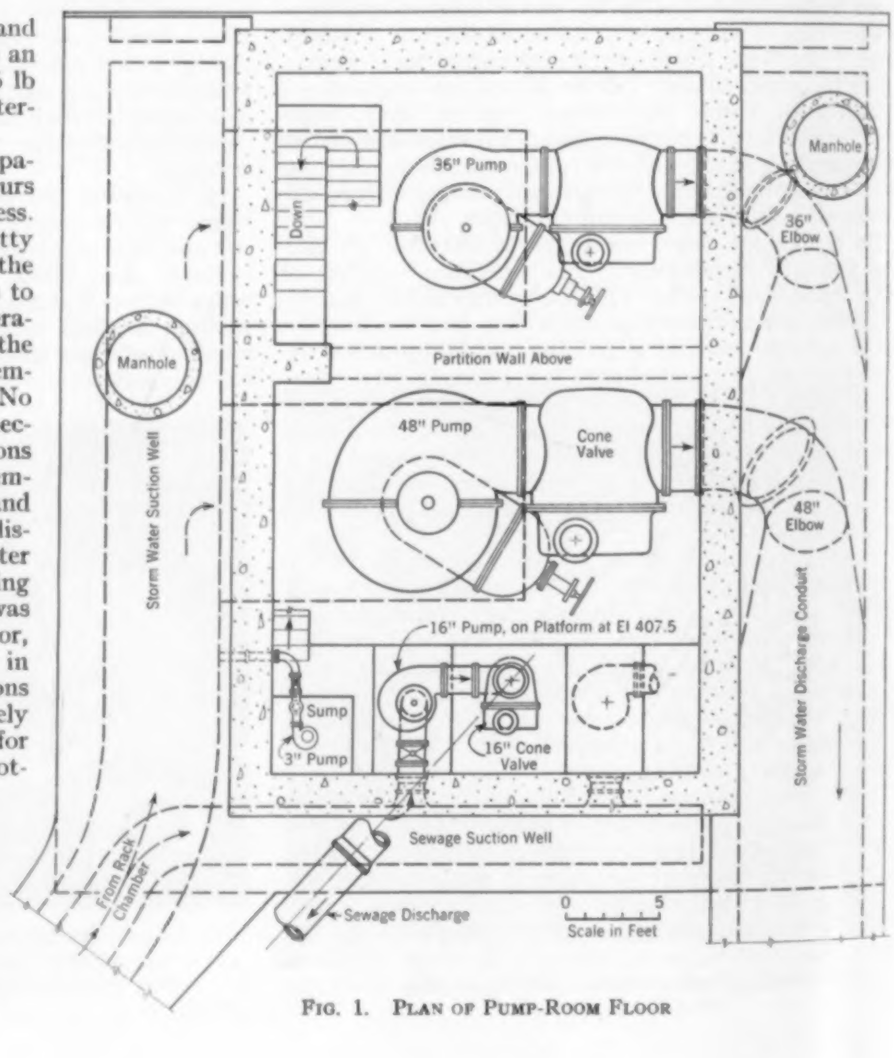


FIG. 1. PLAN OF PUMP-ROOM FLOOR

to a standstill. This complete cycle required 50 sec for the 48-in. pump, 35 sec for the 36-in. pump, and 30 sec for the 16-in. pump. The 3-in. pump was permitted to continue operating under power for 45 sec after the float switch was closed, then permitted to coast to a standstill, giving a complete cycle of 56 sec. After each pump had gone through the complete operating cycle described, it was permitted to rest until the expiration of the remainder of the 60-sec period, when the float switch was again closed and the cycle repeated until 50 starts and 50 stops had been made. Each pumping unit met this test without difficulty. The maximum temperature reached by the starting resistors was 95 C.

4. Each pump was permitted to rotate in reverse for 10 min, by causing water to run backward through the pump while the discharge valve was locked open. When necessary to prevent the speed of the pump from exceeding the normal forward speed, the discharge valve was slightly throttled. This test, made to determine whether the impeller would be loosened or the bearings

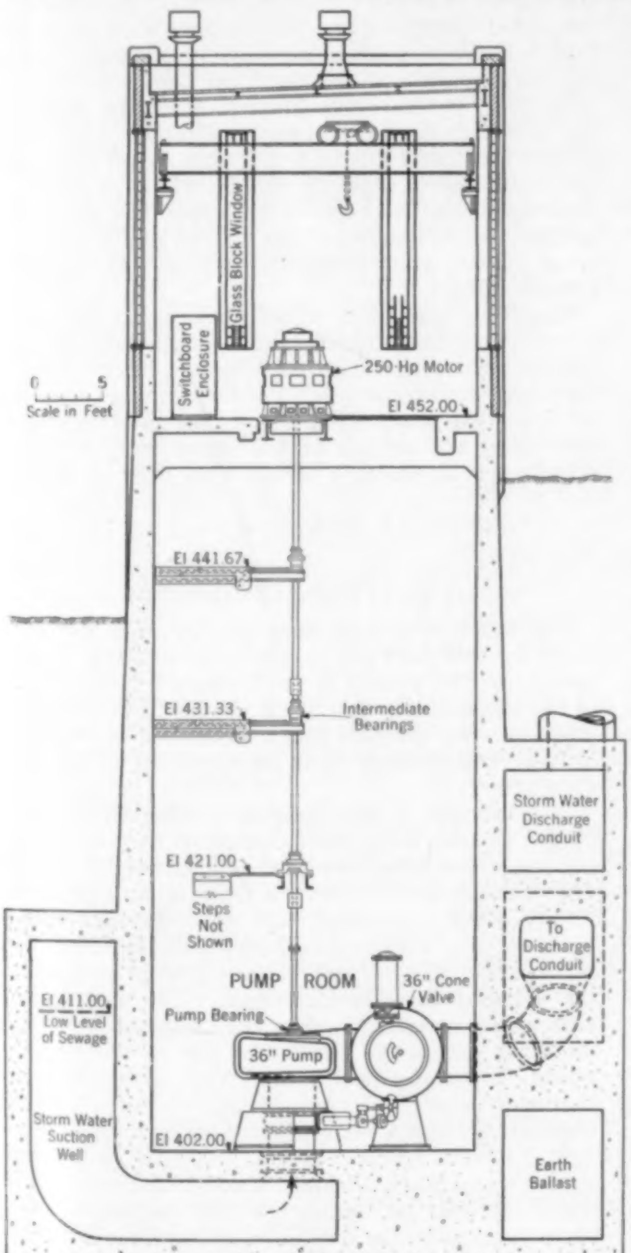
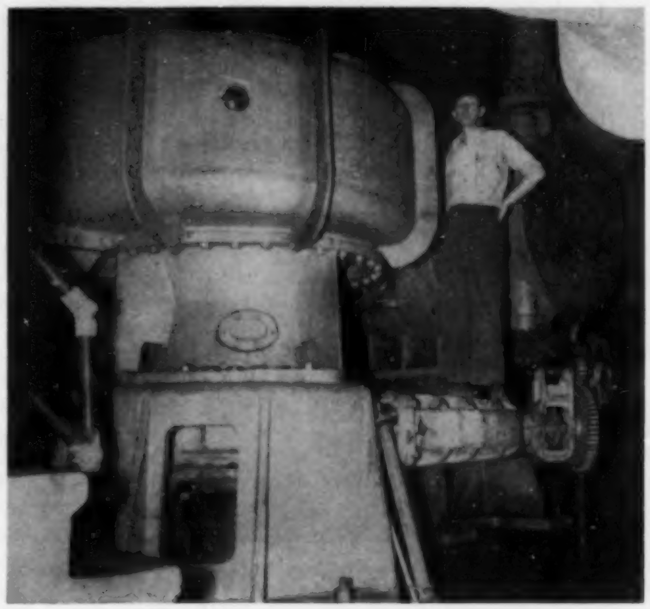


Fig. 2. Typical Cross Section of Sewage Pumping Station



Size of 36-In. Pump Indicated by Man Standing Between Pump and Cone Valve

damaged by reverse rotation, was passed successfully by all the pumps.

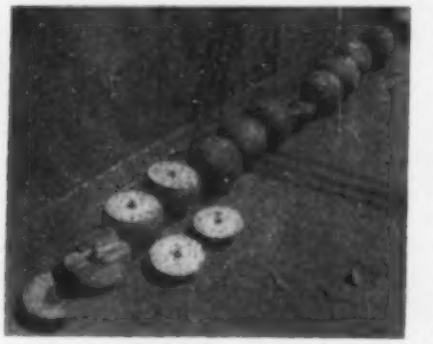
5. Each pump was started and stopped 3 times with the discharge valve locked to remain open. This checked performance of the equipment in case the discharge valve should fail to close as intended. No difficulty was encountered during this test.

PUMPS PASS WOODEN SPHERES, CHIPS, AND RAGS

6. Wooden spheres of the following diameters were passed through the pumps: 8 in. for the 48-in. pump, 6 in. for the 36-in. and 16-in. pumps, and 2 in. for the 3-in. pump. It was necessary that each sphere have a specific gravity of slightly more than 1.0 in order to facilitate its entrance into the pump suction. This was obtained by drilling a hole in each sphere and filling the hole with just enough lead to give the desired result. Twelve spheres were passed through each pump, the spheres being dropped one at a time into the suction well while the pump was operating, and then caught by a wire screen placed in the discharge conduit. The pumps passed most of the spheres satisfactorily, although some were broken up into the segments of which they were originally constructed, and some were dented and otherwise damaged by the pump impellers. The 48-in. pump passed 7 spheres whole and the other 5 in various stages of disintegration (see an accompanying photograph). The 36-in. pump passed 3 spheres whole and 7 in various stages of disintegration, no recognizable trace being found of the other 2. The 16-in. pump passed 8 spheres whole and 2 in segments, the other 2 not being recovered. The 3-in. pump passed 12 spheres whole, although some difficulty was experienced when the pump clogged twice when 2 spheres, trying to pass at the same time, lodged in the discharge nozzle.

7. Each pump was required to pass a quantity of wooden chips and blocks of sizes somewhat smaller than the wooden spheres. The quantity varied from $^1/_2$ bu for the 3-in. pump to 5 bu for each of the 36-in. and 48-in. pumps. Some difficulty was experienced in getting the pieces of wood to enter the pump suction, as their tendency was to float in the suction well. However, by placing a few pieces in the flowing stream at just the right time, most of the blocks were drawn through the pumps.

In the case of the 16-in. pump, it was necessary to use a length of 10-in. iron pipe placed in the suction well, with its outlet end pointing directly into the suction piping of the pump and with its inlet end partly submerged at the water surface. In the case of the 3-in. pump, it was necessary to place the blocks (1-in. cubes) in the pump suction singly, as the pump discharge nozzle clogged when 2 or more blocks attempted to pass through at the same time.



TWELVE 8-IN. WOODEN SPHERES AFTER PASSING THROUGH 48-IN. PUMP—PORTIONS OF THREE NOT RECOVERED

8. Each pump was required to pass a quantity of rags, varying in amount from 3 lb for the 3-in. pump to 20 lb for the 48-in. pump. The rags were thrown into the suction well singly while the pump was operating. They passed through without difficulty except that the 3-in. pump had to be stopped twice so that a rag which had lodged in the pump could be removed by hand. Upon restarting the pump each of these rags was successfully passed through. In the case of the 16-in. pump, it was necessary to use the 10-in. pipe previously mentioned to cause the rags to enter the pump suction.

9. The thermal overload relays were tested by passing current through each relay coil while it was disconnected from its normal operating circuit. Three tests were made on each coil, with the current at 130, 230, and 330% of the normal operating current in the coil at full load of the motor. The various intensities of current were obtained by using a transformer and variable resistances in a temporary line feeding from the power or light circuit of the building. The current was maintained at each value, and the time interval observed, until the relay tripped. This time was compared with values taken from curves indicating satisfactory ranges of tripping time for such overload relays. The tripping times observed in the tests varied from 52 sec to $7^{1}/_{8}$ min. After tripping, the relay was permitted to reset itself and the resetting time interval was observed. This test was satisfactorily passed by the overload relays finally installed, although some of the coils originally used had to be replaced by heavier ones.

10. Circuit breakers were tested in the same manner as the overload relays, running the test current through only one phase of each circuit breaker. Three tests were made on each of the breakers for the 30-hp and 5-hp motors, at values ranging from 125 to 300% of the breaker rating. Only two tests were made on each of the breakers for the 300-hp and 250-hp motors because of the difficulty of obtaining the required high values of the test current. For these two breakers the maximum test current was 207% of the breaker rating for the larger breaker (600-amp rating) and 265% of the rating for the smaller breaker (450-amp rating). Several schemes were tried before sufficient current could be sent through these large breakers to cause them to trip. The output of the temporary transformers used was limited, owing to saturation of the iron and to losses in the apparatus, reactance, and so forth. Finally two transformers were used in series, each having a ratio of 200 to 1, and the output current was sufficient to trip the breakers. The actual output of the two transformers was found to be 82% of the computed value based on the transformer ratio. The maximum current sent through the 600-amp breaker (1,240 amp) tripped the breaker in $4^{1}/_{2}$ min. The tripping time of all the breakers under the test-current values was found to range from 13 sec to 54 min.

11. Tests were made to show that the normal automatic operation of the pumps would take place under float control, and also to show that it was impossible to start and operate any two of the main pumps at the same time, either by float switch or by push button. Tests were made to show that the 16-in. pump would dewater all suction wells as well as the interior of the pump house.

12. Finally, head-capacity tests of each pump were made. The capacity was measured at several heads ranging from the minimum ordinary head to the shut-off head, and the power input to the motor was noted during each test. Pump efficiencies were then computed and curves drawn for comparison with guaranteed and "expected" performance. All the pumps met or exceeded their respective guaranteed capacities, though some of the performance curves departed somewhat from the "expected" curves. The greatest departure of the field-test curves from those previously submitted by the contractor was found for the 3-in. pump at low heads, when the actual pump capacity was found to be as much as 30% more than that shown by a shop-test curve. This unexpected over-capacity put an overload of about 17% on the motor, which fortunately was able to take it without difficulty.

The 3-in. pump was tested for capacity by metering a city-water line leading to the sump while the pump was operating, the sump thus forming a reservoir in which the pump was submerged. The larger pumps were tested by filling the sewer from which they take their suction, then using the volume of the water pumped from this sewer reservoir during a certain time interval as a measure of their capacity. Heads were measured at the pump suction and discharge nozzles by mercury manometers.

EXTENSIVE TESTS JUSTIFIED

The value of making such performance tests is indicated by the trouble-free operation attained during the more than two years that have elapsed since completion of the station. No defects or "bugs" have developed to interfere with the automatic operation of the pumps. Weekly maintenance calls have proved to be entirely satisfactory.

Construction of the pumping station was carried out by the Charles E. Cannell Company, of Louisville, Ky., the equipment being furnished and installed by the Kelso-Wagner Company, of Dayton, Ohio, under a subcontract. Pumps, shafts, bearings, and so forth were manufactured by the Worthington Pump and Machinery Corporation, and motors and other electrical equipment by the General Electric Company. The cone and gate valves were manufactured by the Chapman Valve Manufacturing Company. Design of the station and supervision of its construction were under the general direction of Woolsey M. Caye, M. Am. Soc. C.E., technical engineer for the Commissioners of Sewerage of Louisville. John J. Loehr, M. Am. Soc. C.E., was designing engineer and A. H. Boerner, construction engineer. The writer assisted in the design and construction of the station, prepared the specifications, and was in immediate charge of the installation and testing of the equipment for the Commission.

Flexible Sewage Treatment for Army Camps

Two-Stage High-Rate Biological Filters Economically Solve Problem of Rapidly Changing Loads

By Rolf Eliassen, Assoc. M. Am. Soc. C.E.

Associate Professor of Sanitary Engineering, New York University; Sanitary Engineer, Parsons, Klapp, Brinckerhoff and Douglas, New York, N.Y.

THE principle of the biological filter is of course not new, as standard trickling filters also utilize a coating of zoogleal jelly on the rock surfaces to purify the applied sewage. The main difference is in the recirculation of sewage over the filter and in the rate of dosage, which in the new installations is five or more times that formerly used. The new process is particularly adapted to Army camps and other installations where wide load fluctuations occur. Many of the camps are in the South where temperatures are high, stream runoff sluggish, and sanitation of utmost concern. Dr. Eliassen explains in detail how the degree of treatment can be varied to achieve maximum economy under rapidly changing loads to meet the desired B.O.D. in the receiving stream.

PROVISION of adequate sewage treatment at the various posts, bases, and cantonments in operation and under construction for the U.S. Army has proved a complex problem. These military establishments are scattered throughout the continental United States, and also in its possessions and those of Great Britain, in places considered vital to national defense. Nominal capacities vary from 1,000 to 66,000 men, the majority of the camps having from 20,000 to 30,000 men as their capacity ratings.

In a report to the War Department, prepared by Metcalf and Eddy and Greeley and Hansen, in October 1940, the considerations that must be taken into account in the design of sewage treatment plants for army camps were specified. Emphasis was placed on the large variations of flow occurring during each day, and graphs were presented to indicate results based on past experience.

Also, great variations in flow will occur as a result of the fluctuating population at army camps.

The degree of treatment given the sewage will vary with the dilution requirements of the stream or other body of water receiving the effluent. Furthermore, for any one plant, the flow in the receiving stream will vary with the season. The sewage treatment plant should be capable of economic operation to give the desired degree of treatment under the circumstances pertaining at the time. It should not be necessary to give the sewage as high a degree of treatment when the stream possesses the capacity for adequate self-purification.

For obvious reasons, many of the camps are located in the southern part of the United States and in the tropics, where temperatures are high during many months of the year. The surrounding land may be quite flat, and some of that downstream may be swampy. Before reaching large rivers or the sea, the stream may meander slowly through lowlands, often past populated areas. Under such circumstances the high temperatures will encourage decomposition and deoxygenation, and there may be little or no opportunity for reaeration.

When such conditions prevail, it is desirable to have a sewage treatment plant that will meet the following requirements:

1. High degree of treatment
2. Uniformity of results
3. Ability to withstand shock loads
4. Ease of control of operation with unskilled labor
5. Low installation costs
6. Low operating costs
7. Flexibility of design and operation to care for large variations in connected population
8. Means for preventing septic action in the primary clarifier during periods of low flow and high temperature
9. Freedom from mosquitoes, flies, and other insects

A survey of the plants recently installed in large army posts and cantonments shows that the method of treatment which best complies with these requirements is that employing high-rate biological filters. The writer was called upon to make a study of the adaptability of this method of treatment to one particular defense project. Special attention was paid to the system using two-stage high-rate biological filters, commonly known as the biofiltration system, as the study revealed that this would most closely approximate the desired results.

The two-stage biofiltration system employs the flow sheet shown in Fig. 1. After passing through the usual preliminary steps such as screening and grit removal, the raw sewage enters the primary clarifier. In this tank most of the settleable solids are removed, as in any other process of treatment. In addition, a quantity of effluent from the primary filter returns to the primary clarifier for detention and clarification. The mixing of the raw sewage with the filter effluent serves to encourage aerobic conditions in the primary clarifier and thus to minimize the possibility of odor formation. After having passed through the circuit of the filter and the clarifier the desired number of times, the sewage passes into the secondary circuit. This consists of a secondary filter

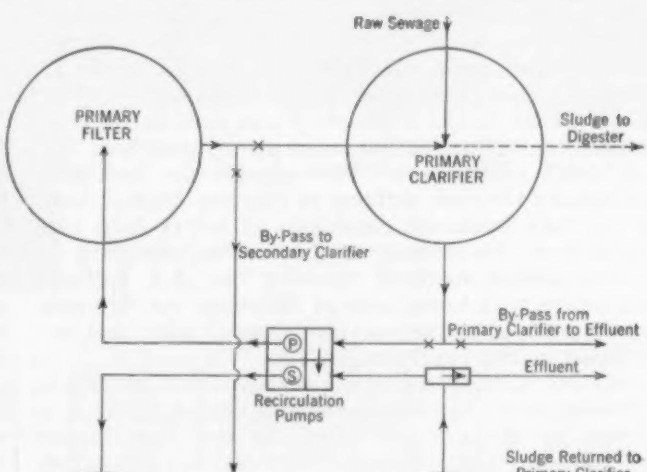


Fig. 1. Plant Layout for Two-Stage Biofiltration

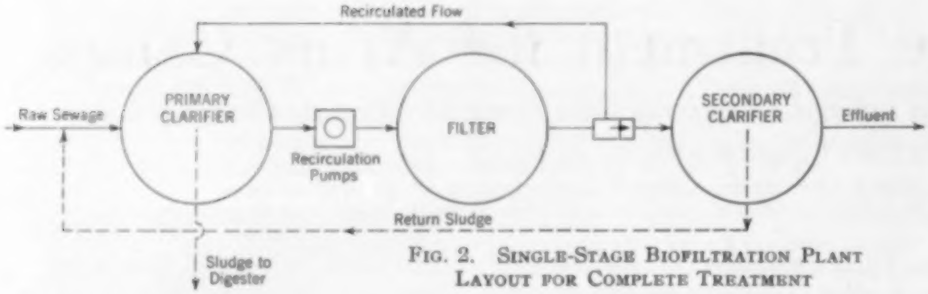


FIG. 2. SINGLE-STAGE BIOFILTRATION PLANT LAYOUT FOR COMPLETE TREATMENT

and secondary clarifier, similar in most respects to the primary units. The sewage is recirculated through the secondary system the desired number of times before passing out as plant effluent. Recirculation is accomplished by high-efficiency, low-head propeller pumps. The various units of the plant may be arranged in almost any desired sequence of elevations to conform with the topography or other conditions met with at the particular site.

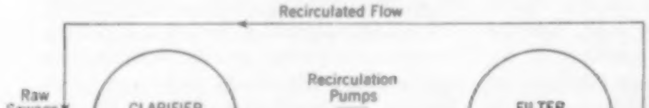


FIG. 3. SINGLE-STAGE BIOFILTRATION PLANT LAYOUT FOR INTERMEDIATE TREATMENT

The high-rate filters are based on the same principles as the standard trickling filters, in that sewage is applied to a bed of rock and allowed to trickle through in the presence of air. A coating of zoogleal jelly, alive with aerobic organisms, forms over the surface of the rock and accomplishes the purification of the applied sewage. Whereas standard filters are usually dosed intermittently at low rates, the high-rate filters are dosed continuously at rates five or more times those formerly used.

Uniform quality of effluent is assured through the sound principles upon which the operation of the filters is based. When settled sewage is repeatedly passed through a filter bed at a relatively high rate, it has been found that a uniform action takes place throughout the entire depth of the bed. This permits the biological organisms on the rock surfaces to function continuously close to their optimum conditions of metabolism and reproduction. In contrast to the seasonal sloughing of the accumulated material covering the rock surfaces which occurs with lower rates of filtration, the high-rate filters unload a portion of the zoogleal jelly and accumulated matter continuously.

Complete stabilization of the sewage is not secured in the filter alone. The suspended and colloidal matter is removed by the zoogleal jelly. As this jelly breaks away from the rock, it passes with the sewage to the clarifier, which acts as a detention tank. The presence of organic matter, biological organisms enveloped in a flocculant matrix, and the dissolved oxygen in the sewage as the result of its having passed through the aerobic filter, all combine to bring about a condition similar to that met with in the activated sludge process. As the metabolism of the aerobic organisms oxidizes the organic matter, the sedimentation of the floc permits a clear overflow from the clarifier. With an average raw sewage strength of 260 ppm of suspended solids and 200 ppm of B.O.D., operating results have indicated that a flow sheet like that in Fig. 1 will give a removal of 90% of the suspended solids and B.O.D.

When the dilution ratio of river water to sewage plant effluent is increased, it will be possible to employ a flow sheet giving a somewhat lower degree of treatment. Figure 2 illustrates a single-stage biofiltration system using the same equipment as in Fig. 1, but by-passing the secondary filter. This cuts out one set of recirculation pumps and accomplishes a power saving. The removals that may be expected are approximately 85% of both suspended solids and B.O.D.

By employing only one filter and one settling tank, it is possible to obtain single-stage intermediate treatment, as shown in Fig. 3. The filter effluent is recirculated back to the primary settling tank to mix with the incoming raw sewage. Part of the effluent from the settling tank goes to the filter and the remainder becomes plant effluent. An average reduction of suspended solids and B.O.D. of approximately 70% may be obtained through the use of this flow sheet.

Primary treatment may be accomplished by permitting the raw sewage to flow through the primary clarifier and by-passing all the other units of the plant shown in Fig. 1. Approximate removals of 55% of suspended solids and 35% of B.O.D. can readily be obtained.

It stands to reason that the lower the desired B.O.D. in the receiving stream, the higher the degree of treatment required, or the larger the amount of dilution water necessary. To illustrate this, consideration will be given to the treatment of a raw sewage containing 200 ppm of B.O.D., and subjected to the types of treatment shown in Table I, with the corresponding removals.

TABLE I. RESULTS OF FOUR TYPES OF BIOFILTRATION TREATMENT ON RAW SEWAGE CONTAINING 200 PPM OF B.O.D.

Treatment	Percentage Removal of B.O.D.	B.O.D. of Plant Effluent in Ppm
Two-stage complete	90	20
Single-stage complete	85	30
Single-stage intermediate	70	60
Primary	35	130

For any desired B.O.D. of the river below the plant, the ratio of plant effluent to the dilution water may be computed, knowing the B.O.D. of the effluent and of the river. Assuming a B.O.D. of zero in the river, the number of volumes of dilution water required for each of these types of treatment has been computed for various desired concentrations of B.O.D. in the river below the plant. This relationship is shown in Fig. 4. From this series of curves it may be seen that the operator can vary the treatment to maintain the

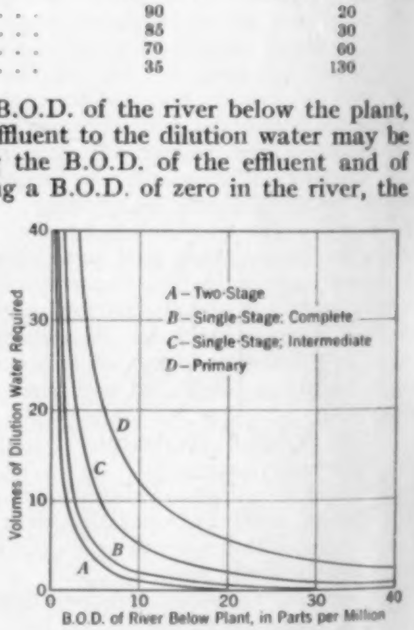
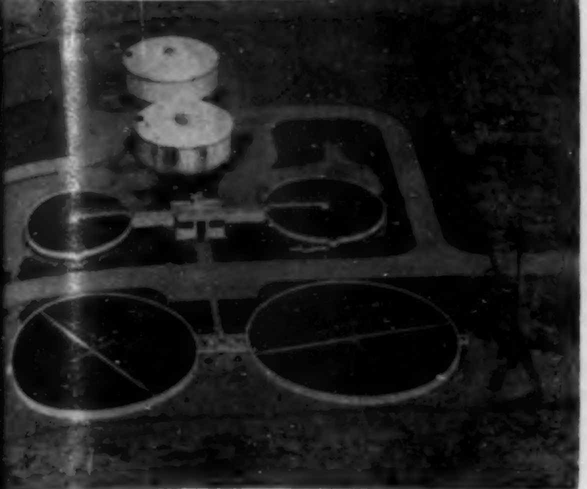
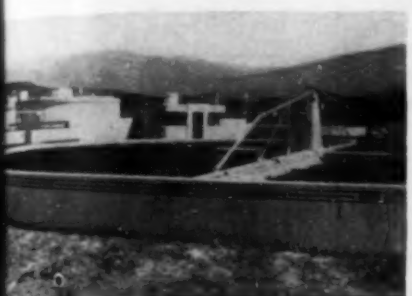


FIG. 4. RELATIONSHIP BETWEEN DESIRED B.O.D. AND VOLUMES OF DILUTIONS FOR VARIOUS DEGREES OF TREATMENT

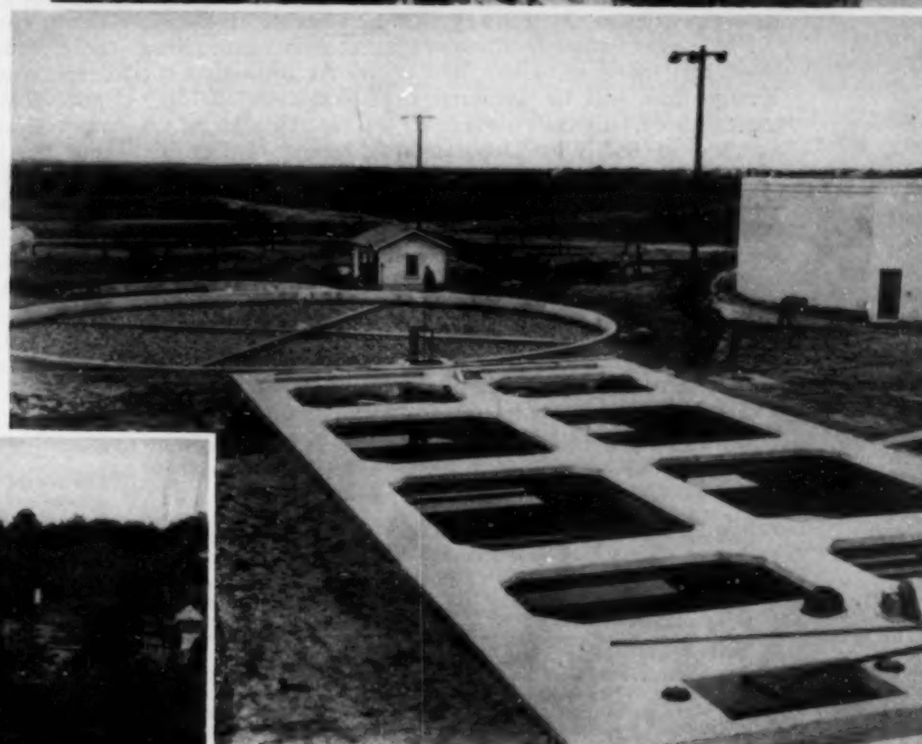


…e) Aerial View of Two-…e Biofiltration Plant …Santa Paula, Calif.

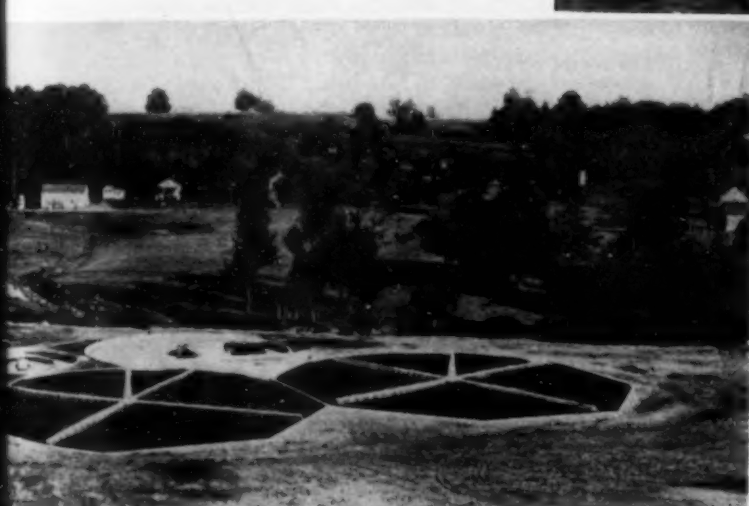
(Right) Completed Two-Stage Biofiltration Plant at Fort Bragg from the Air



…ary Biofilter—Ventilation Ports in …Two-Stage Plant of Santa Paula, Calif.

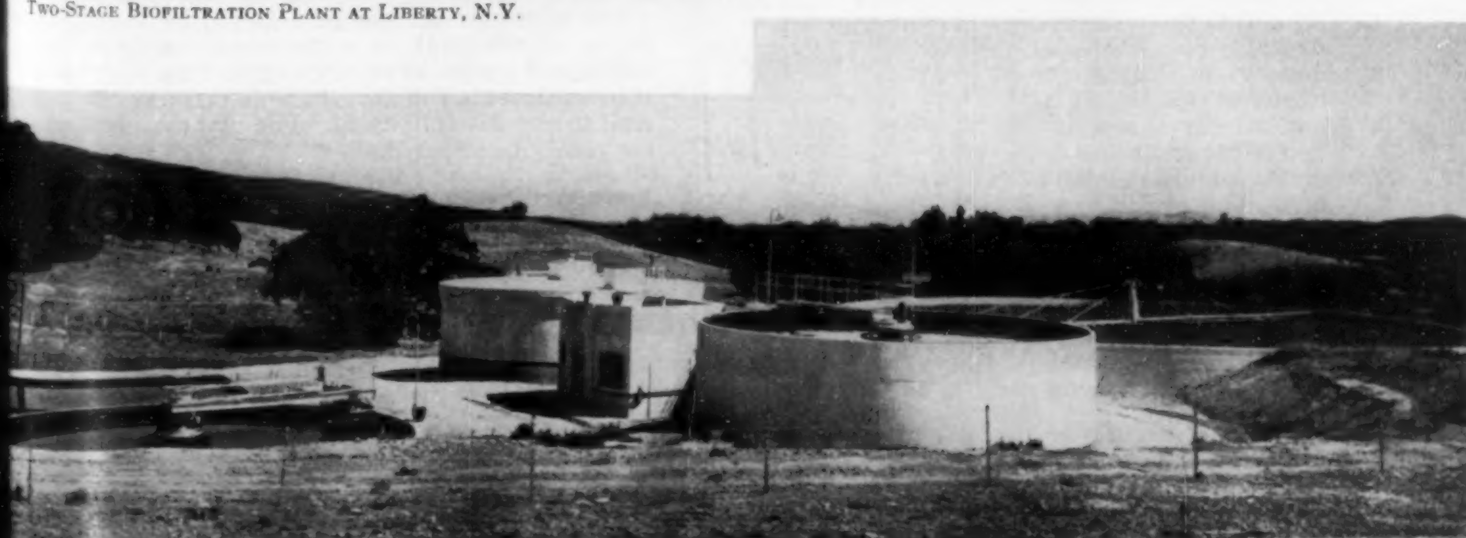


Primary Clarifier and Filter in Single-Stage Plant at Camp Berkeley, Abilene, Tex.



Two-Stage Biofiltration Plant at Liberty, N.Y.

Single-Stage Biofiltration Plant for Sonoma State Home, Eldridge, Calif.



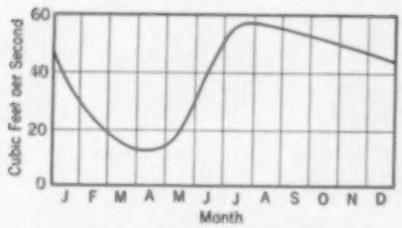


FIG. 5. AVERAGE FLOW IN RIVER AT OUTFALL SEWER

proper relationship between the strength and the amount of sewage, the B.O.D. of the receiving water, the quantity of stream flow, and the requirements of the stream.

To apply the foregoing results to a typical treatment problem at an army camp, it will be assumed that the average flow in the stream receiving the effluent varies according to the curve in Fig. 5. This is typical of conditions met with at some of the camps in the South. Furthermore, it will be assumed that the maximum population of the camp is 50,000. At different times the population may be 20,000, or even as low as 10,000, as the exigencies of the military situation may dictate.

For camps in the South more water may be required than for those in colder climates. Accordingly, the sewage flow will be assumed to average 100 gal per capita daily, instead of the 70 gal mentioned as an average in the War Department's report of October 1940. For the camp populations mentioned in the preceding paragraph, the flows will be 5 mgd, 2 mgd, and 1 mgd, respectively. The sewage flows, together with the yearly variation of stream flow shown in Fig. 5, have been used as the basis of the following studies.

In order to treat the sewage from this camp by the biofiltration system, it would be necessary to design a plant with a nominal rating of 5 mgd. It will be assumed that the sewage must be lifted 15 ft from the level of the intercepting sewer to the plant elevation. For a two-stage biofiltration plant the various major units of equipment required, together with their power requirements, would be as shown in Table II.

TABLE II. MAJOR UNITS, WITH THEIR POWER REQUIREMENTS, OF A TWO-STAGE BIOFILTRATION PLANT

Number	Equipment	Total Installed Horsepower	Hours per Day of Operation
4	Raw-sewage pumps.	25	24
2	Primary recirculation pumps.	30	24
2	Secondary recirculation pumps	30	24
3	Primary clarifiers	1.5	24
2	Secondary clarifiers	1.0	24
4	Rotary distributors	0	24
2	Sludge pumps	10	12
4	Digesters	10	12

For each type of treatment the power consumption may be computed for the range of flows encountered at the plant. This has been studied for the 5-mgd biofiltration plant just mentioned, and the results are indicated in Fig. 6. The difference in operating cost between the intermediate and complete degrees of single-stage treatment is slight, as it involves only the elimination of the small motors or the secondary clarifiers. The two may be considered as coinciding with curve *B*.

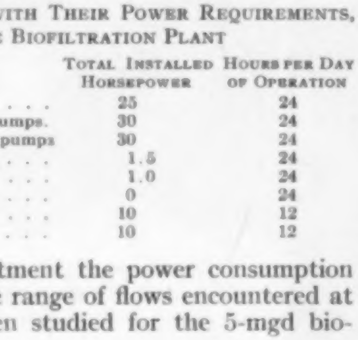


FIG. 6. RELATIONSHIP BETWEEN POWER CONSUMED AND SEWAGE FLOW FOR VARIOUS DEGREES OF TREATMENT

To carry the specific case further, let it be assumed that the plant described is treating an average yearly flow of 2 mgd of sewage, and that the river characteristics are such that a B.O.D. of 4 ppm is required in the stream below the plant. Assuming that the river flow follows the curve in Fig. 5, and that the B.O.D. of the river above the plant is zero, the dilution requirements for each degree of treatment may be taken from the curves in Fig. 4. These values are shown in Table III. In the last column of this table are the minimum river flows required before each of the types of treatment may be applied to the 2 mgd of sewage.

These latter values of river flow may be applied to Fig. 5 to determine the actual periods of the year during which each type of treatment may be employed. These are shown in Table IV. From Fig. 6, the daily power requirements may be obtained. The corresponding power consumption for each period may thus be computed and the annual cost for power calculated. For the operation of the plant under consideration, at a flow of 2 mgd, and at a charge of 1 cent per kwhr, the power cost would be $2,145 per year. See Table IV.

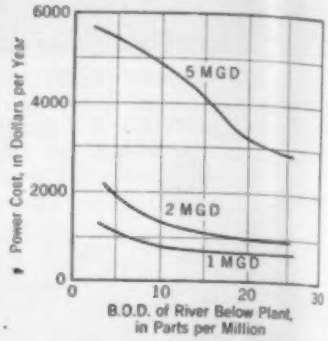


FIG. 7. RELATIONSHIP BETWEEN DESIRED B.O.D. AND POWER COST AT VARIOUS SEWAGE FLOWS

TABLE III. DILUTION REQUIREMENTS FOR DIFFERENT DEGREES OF TREATMENT

		Minimum River Dilutions Required	
Treatment	B.O.D. of Effluent in Ppm	Ratio of River Flow to Sewage Flow (From Fig. 4)	Flow in River in Cu Ft per Sec
Raw sewage	200	....	....
Primary sedimentation .	130	31.5	97.2
Single-stage intermed. filt.	60	14.0	43.2
Single-stage complete filt.	30	6.5	20.1
Two-stage filtration. . .	20	4.0	12.4

In a similar manner the power costs for various sewage flows and different B.O.D. requirements of the stream may be computed. Figure 7 presents a summary of such computations and shows the relationship between yearly power costs for various sewage flows and different values of the B.O.D. of the river below the plant, with sewage treated to assure a B.O.D. of less than 4 ppm in the river with the variation in flow shown in Fig. 5.

These studies have been made for one specific plant. Similar studies can readily be made for the conditions met with at any army camp or municipality. It is simply necessary to apply the variations in stream flow and dilution requirements of the river to the contemplated flow of sewage to be treated in the manner described.

The economy that can be achieved by varying the degree of treatment to meet stream requirements is emphasized by the series of curves in Figs. 4, 6, and 7. It is significant to note that the biofiltration system lends itself to such flexibility of operation that these economies can readily be achieved.

TABLE IV. TIMES OF YEAR FOR EACH TYPE OF TREATMENT, WITH COSTS

No. of Months	Dates	Treatment Required	Power, Kwhr per Day	Total Kwhr	Cost for Period
2	Jan. 1 to Feb. 28	Single-complete	537	31,600	$ 316
2.5	March 1 to May 15	Two-stage	800	60,800	608
1	May 16 to June 15	Single-complete	537	16,600	166
6.5	June 16 to Dec. 31	Single-intermed.	530	105,500	1,055
		Average yearly power cost			$2,145

Foundation Tests for Los Angeles Steam Plant

Subsurface Investigations, Pile-Load and Soil-Load Tests Determine Foundation Design for Heavy Structure near Harbor's Edge

By W. F. SWIGER, JUN. AM. SOC. C.E.

OFFICE ENGINEER, ROBERT V. LABARRE, CONSULTING FOUNDATION ENGINEER, LOS ANGELES, CALIF.

ACCESS TO PILE TESTING CHAMBER WAS THROUGH SMALL TIMBERED TUNNEL

IT is a well-known fact that the behavior of groups of piles cannot be predicted from the behavior of a single pile. For this reason it was necessary to load the piles in groups in this investigation. Two groups of three, at different spacings, were tested. The results will be interesting to the designer of foundations, even though the final decision in this case was that spread footings were better adapted than piles to the particular subsurface conditions obtaining. Mr. Swiger's paper was originally presented before the Soil Mechanics and Foundations Division at the Society's San Diego Convention.

FOUNDED under the direction of E. F. Scattergood and the late William Mulholland, M. Am. Soc. C.E., the Los Angeles Bureau of Power and Light is the sole distributor of electric power within the boundaries of that municipality. Its growth has been even more rapid than that of the city it serves. A number of plants have been built or purchased from other power companies and a great transmission line built to carry power from Boulder Dam to the city 265 miles away. To offset the serious power shortage that would follow the disabling of this line and to serve as a power source for the anticipated growth of the city, a large steam plant is being built within the city limits. Planned for an ultimate capacity of 365,000 kw, construction will proceed in five steps of which the first unit, of 65,000 kw, is now under construction. The second unit is scheduled for construction in the immediate future.

The site selected for the plant lies in the southern part of Wilmington District of the City of Los Angeles a few hundred yards from the West Basin of the harbor. Early surveys of this area, which date back to 1859, indicate that at that time part of the site was awash at low tide and the remainder on tidal flats. In the development of the harbor, prior to 1910, the site was covered to a depth of from 12 to 15 ft by material dredged from what is now the West Basin. In 1926 and in 1932 a considerable amount of exploratory work was done at the site in anticipation of construction which never developed. Although the general nature and distribution of the underlying soils were known from these early explorations, the physical properties of the materials and their behavior under load were unknown. Therefore the information available was considered inadequate for the design of foundations for a structure of this magnitude, and accordingly a comprehensive program of sampling and testing was adopted.

Although the final design of the structure and the loads were undetermined at the time of these investigations, the general features to be met in the selection and design of the foundations were known. The chief problems to be solved were:

1. Settlements must be small and differential settlements reduced to a minimum. This was particularly true of the turbine foundations since these machines are delicately balanced, with small tolerances, and are very susceptible to tilting. This requirement meant that, if pile foundations were adopted, the action of piles in groups must be studied and provided for. Similarly, if spread footings were used, they must be properly proportioned to keep settlements resulting from elastic deformations of the soil within the desired limits. And finally it was necessary to determine the possibility and magnitude of areal settlements, which are to some extent independent of the type of foundation used.

2. Because the construction of the steam-electric plant was to be done in several steps, the type of foundation selected must be satisfactory both as a single unit and as a part of a larger unit. Differential settlements

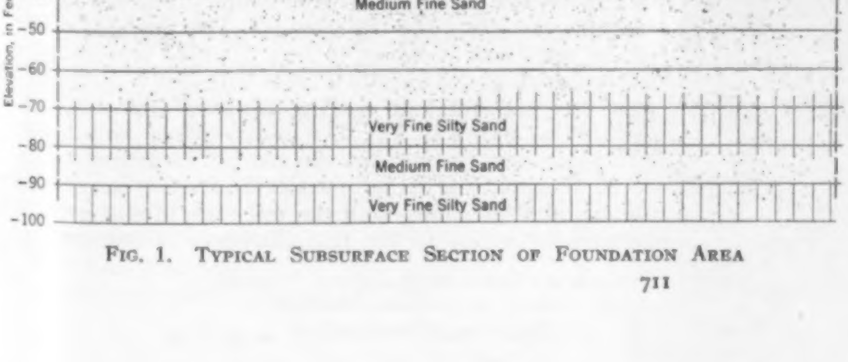


FIG. 1. TYPICAL SUBSURFACE SECTION OF FOUNDATION AREA

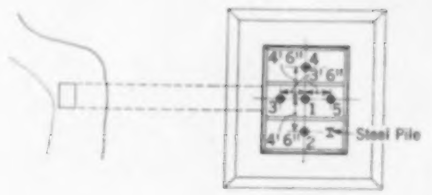


FIG. 2. ARRANGEMENT OF PILES FOR GROUP LOAD TESTS

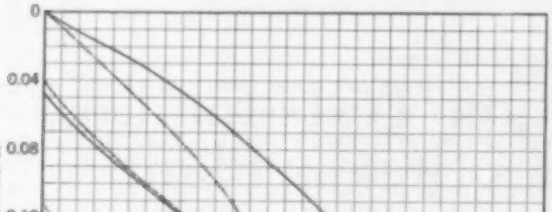


FIG. 3. RESULTS OF LOAD TEST ON PILES AT 3-FT 6-IN. SPACING

between existing and new construction must be minimized and the foundations so designed as to permit future plant expansion at a minimum of expense and with no loss of stability of the existing foundations during later excavation.

3. An earthquake-resistant type of foundation was indicated since the site lies only a few miles from the Inglewood Fault in a zone of considerable seismic activity. The principles of seismic design are as yet only partially understood. However, past experience seems to indicate that isolated footings should be avoided. Either a continuous system should be used, or, at the least, the footings should be well tied together by a system of struts.

Further, since problems of construction may radically alter the cost of various types of foundations, it was necessary to consider construction methods in making studies of comparative economy. Since the site is located only a short distance from tidewater, the most important problem was believed to be the control of the sides of excavations, which could be accomplished either by sloping them back or by sheeting and under-watering. This latter problem was complicated by an existing excavation made in 1932, which had since filled with water.

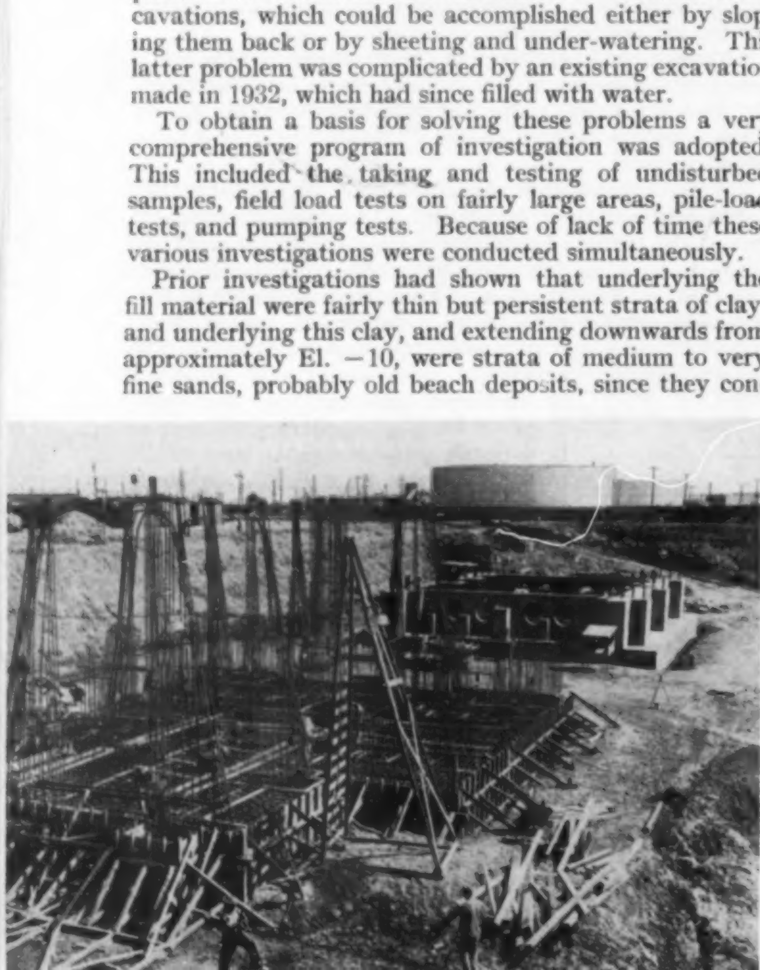
To obtain a basis for solving these problems a very comprehensive program of investigation was adopted. This included the taking and testing of undisturbed samples, field load tests on fairly large areas, pile-load tests, and pumping tests. Because of lack of time these various investigations were conducted simultaneously.

Prior investigations had shown that underlying the fill material were fairly thin but persistent strata of clay, and underlying this clay, and extending downwards from approximately El. −10, were strata of medium to very fine sands, probably old beach deposits, since they contained some shells. The depth of these deposits was unknown. However, borings carried down 250 ft had shown them to extend at least that deep. On the basis of this information, it was decided that the underlying sand probably represented the most satisfactory foundation material. Accordingly, this stratum was given the most serious consideration in the testing and sampling program. Since the relative location and nature of the underlying soils were known, it was not considered necessary to obtain a continuous record of the strata encountered, and samples were taken at predetermined intervals only.

Sampling was done with a modern type of spoon, quickly but smoothly forced into the soil by hydraulic jacks to avoid the disturbance caused by ramming. Uncased bore holes and fairly heavy drilling fluid were used to minimize disturbance of the soil due to changing of the stress conditions at the point of sampling. After removal from the spoon the samples were placed in cans and packed with damp sand. The cans were then sealed with wax to make them air tight, and removed to the laboratory. This method of packing was quite effective and samples generally showed little change in moisture content. In the laboratory, routine tests of moisture content, wet and dry density, and void ratio were made on all samples.

The soil profile of the site as determined in these sampling operations and from existing records is shown in Fig. 1. From El. 15 to approximately sea level was dredged fill, largely silty clay, but containing some pockets of sand and gravel. From El. 0 to about El. −5 a medium stiff to medium soft silty clay was found. Underlying this and extending about to El. −10 was a very stiff, hard, sandy clayey silt of a greenish color. Approximately at this elevation the clayey silt merged into fine well-graded clean sands, which with some variations in fineness and density were of unknown depth.

As piles had been used in the past in this area to support structures of a similar nature, the possibility of their use here was given serious consideration. It has long been recognized that the behavior of groups of piles cannot be predicted from the behavior of a single pile by any simple direct expression. That is, even for soils in which consolidation is not a factor, the load for equal settlement for, say, three piles is not three times the load on a single pile. In recognition of this fact, group testing of piles was used in this investigation. Two groups of three piles at different spacings were tested. As far as the writer knows, these tests are unique in the accuracy and care used in conducting them and in the method of testing the pile groups. The arrangement of these tests was as shown in Fig. 2. Five wooden piles were driven in the form of a cross with 3-ft 6-in. spacing one way and 4-ft 6-in. spacing the other. A steel pile, located as shown in Fig. 2, was also driven and tested. All piles were driven in a sheeted pit excavated to El. −8. This pit was decked over at El. 0 using heavy steel beams and backfilled with the soil excavated, leaving a tunnel for access to the test chamber. Load was ap-



REINFORCING STEEL IN PLACE FOR TURBINE FOUNDATION, WITH COMPLETED BOILER FOUNDATION IN BACKGROUND

plied to the piles by hydraulic jacks reacting against the decking beams, and settlements were measured by gages reading to 0.001 in., the gages being supported from the walls of the test pit. The hydraulic jacks were of a special frictionless design and were carefully calibrated by a commercial laboratory before use. To insure accuracy and care in the carrying out of the test, the technicians in charge were thoroughly impressed with the necessity of taking and keeping accurate records. That they took this to heart is shown by the fact that they were quite worried by what was and is an unexplained periodic variation of about 0.002 in. in the settlement readings.

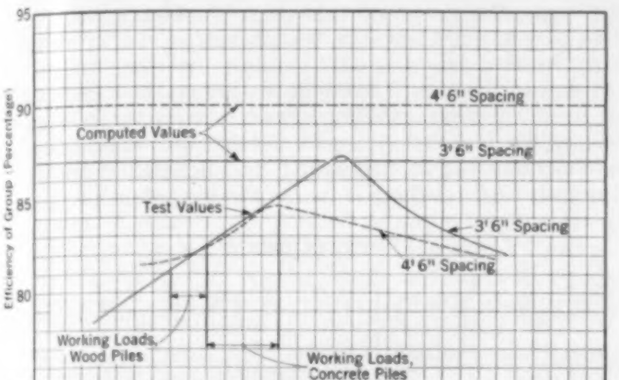


Fig. 4. Computed and Test Values for Efficiencies of Pile Groups

The wooden piles were loaded in groups of three in a row to identical, predetermined settlements, the force acting on each pile being adjusted as necessary to maintain these settlements under each increment of load. This loading simulates that on a group of piles connected by a very rigid cap so that the settlement of each pile is the same. Thus the load on each pile as recorded in this test represents the load it would carry in a group of three, and gives a graphic picture of the distribution of load to the individual piles under such conditions.

Results of the tests on the piles at 3-ft 6-in. centers are shown in Fig. 3. The similarity between the records of the two outside piles will be noted as will be the much smaller load carried by the center pile at a settlement equal to that of the outside piles. In fact the load carried by the center pile at a settlement of 0.1 in. amounts to slightly less than 70% of that carried by the outer piles. The values shown in Fig. 3 are just as recorded in the tests. If a correction is made for the elastic deformation of the piles in order to show the effects of loads on the soil only, this reduction in load-carrying capacity becomes even more apparent. In this case the load carried by the center pile at 0.1 in. settlement is slightly less than 60% of that carried by the outer piles.

If the efficiency of a group of piles be defined as the ratio of the load carried by the group to n times the load carried by a single pile, n being the number of piles in the group, then we may plot the group efficiency of these two tests against the load on the most heavily loaded pile, using the formula,

$$\text{Efficiency} = 1 - \theta\left[\frac{(N-1)M + (M-1)N}{90\,MN}\right]$$

in which

N = number of piles in a row
M = number of rows
D = diameter of pile
S = center-to-center spacing of piles

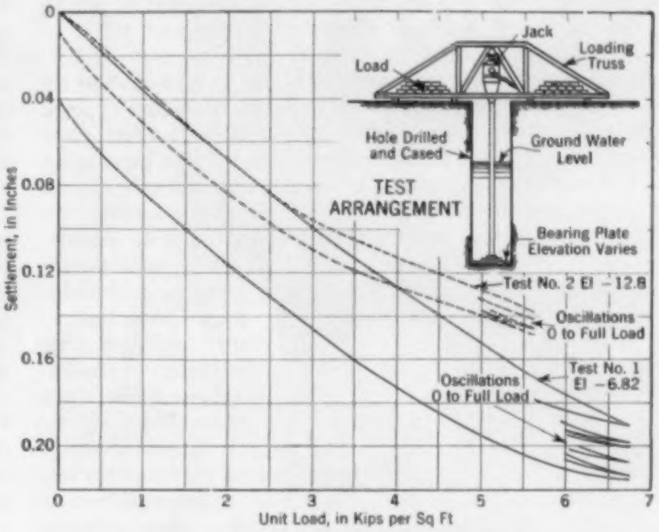


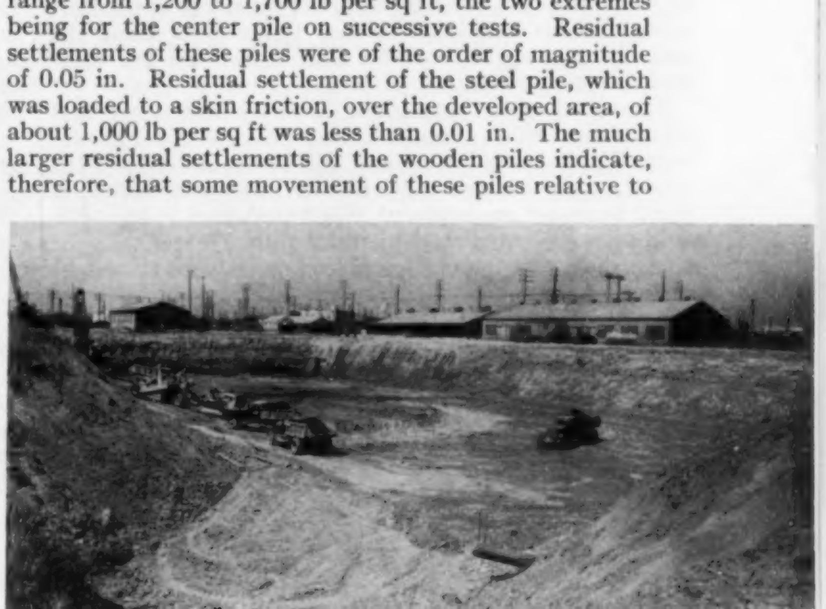
Fig. 5. Arrangement and Results of Soil Load Tests

θ = D/S, in which θ is numerically equal to the angle, in degrees

Figure 4 shows the results of such an analysis. Both tests show the same characteristic shape of curve, indicating increasing group efficiencies up to the load at which movement of the pile relative to the soil occurred. Although it is probable that various correction factors have been proposed for reducing loads on piles in groups, the only one familiar to the writer is that given, which comes from the Uniform Building Code of the Pacific Coast Building Officials Conference.

Efficiencies for these two tests computed by this formula are 90% for the 4-ft 6-in. spacing and 87% for the 3-ft 6-in. spacing. Actual efficiencies for the working loads on the piles were about 83% for both spacings. It is of course impossible to draw accurate conclusions from only two tests. However, for the soil conditions at this site the preceding formula gives reasonable results.

The exact reason for the very definite break in the load-settlement curve of the center pile for both the group tests (Fig. 4), which was noted to a lesser degree in all the tests, is unknown. Terzaghi has defined the break or change of curvature which frequently occurs in pile test curves as the load at which the skin friction of the pile is overcome and movement of the pile relative to the soil occurs. If this definition is accepted and skin friction values are computed for these tests, they will range from 1,200 to 1,700 lb per sq ft, the two extremes being for the center pile on successive tests. Residual settlements of these piles were of the order of magnitude of 0.05 in. Residual settlement of the steel pile, which was loaded to a skin friction, over the developed area, of about 1,000 lb per sq ft was less than 0.01 in. The much larger residual settlements of the wooden piles indicate, therefore, that some movement of these piles relative to



Existing Excavation Was Completely Unwatered Prior to Start of Excavation for First Unit

the soil took place. Since no movement relative to the soil was recorded for frictional values of 1,000 lb per sq ft, the indicated limiting values of friction of 1,200 to 1,700 lb per sq ft seem reasonable.

As a check on the computed bearing values, and as an aid in proportioning spread footings, in case this type of foundation should be chosen, two soil load tests were made (Fig. 5). One of these brought a load to bear upon the stiff sandy clayey silt at El. −6.8, and the other upon the dense fine sand at El. −12.8. Load was applied by calibrated hydraulic jacks reacting against a dead weight, and settlements were measured by gages attached to an independent support. In developing the data from these tests, it was necessary to correct for elastic deformation of the pipe column and for temperature variations during the progress of the test.

PRECISION TEST JACK, ON TOP OF TEST PILE, WAS LOCATED IN TEST CHAMBER BETWEEN TIMBER CROSS BRACES

The plates used for these tests were circular, with an area of 9 sq ft, which was considered about the minimum area that would give reliable results. Each plate was loaded in increments of 500 lb per sq ft, until total loads of 6.7 kips per sq ft and 5.6 kips per sq ft, respectively, had been reached, readings being taken at regular intervals. Each increment of load was maintained until the plate came to rest. Rapid oscillations of load from zero to this maximum value to simulate transitory loads, as from seismic forces, produced only slight additional settlements. The settlement at maximum load for both these tests was only about $^1/_5$ in. and residual settlements were about $^1/_{16}$ in. Note that settlements for these two different soils were, within permissible limits, approximately equal, the difference at a load of 4 kips per sq ft being only about 0.03 in. This similarity of behavior of these two soils under load was also borne out by consolidation tests on undisturbed samples.

Routine laboratory tests made in this investigation showed the upper portion of the sand to be the most dense, with an average void ratio for the first 15 to 20 ft of about 0.55. Below this depth the void ratio increased slightly, the average being about 0.75. Consolidation tests made on representative samples of these sands showed, as would be expected, that the dense uppermost sands deform considerably less under load than the underlying material, and for that reason are the most desirable for foundation purposes.

Since the underlying materials were less dense and more compressible, transfer of load past the upper harder sands by piles could in no way add to the stability of the structure or decrease settlements. Analyses based on these tests for an assumed pile foundation using 30-ft steel piles indicated settlements slightly greater than for an assumed mat foundation placed directly on the upper surface of the sand.

As previously stated, load tests on the stiff sandy silt immediately overlying the sand, and on the sand, had shown very small differential settlements, especially in the working-load range. Consolidation tests made on these two materials showed almost identical stress strain characteristics. Accordingly, for those portions of the area in which the stiff clayey silts extended slightly below the recommended foundation plane, El. −9, founding of the structure on this material was considered acceptable. Under the conditions existing at the site, the resulting differential settlements will be negligible.

Comparison of the relative cost of founding directly on the soil at El. −9, or of using short wooden piles to carry the load to the desired foundation stratum, showed clearly that the former would be the more economical and satisfactory method, even though it would involve considerably more excavation and the control of ground water. Further, speed was of prime importance and the use of this type of foundation would shorten the construction time and avoid delays due to lack of materials. Accordingly, the design selected (Fig. 6) was a continuous system of combined footings, the principles of continuity of construction being used to aid in resisting seismic forces and to distribute live-load concentrations such as those resulting from traveling cranes. Since for footings of this width founded on sand, settlements are almost independent of the footing width and depend primarily on the unit load on the soil, these footings were proportioned on the basis of full dead load plus actual live or operating loads. The analyses and soil load tests had indicated settlements well within permissible limits if unit soil pressures were kept to moderate amounts.

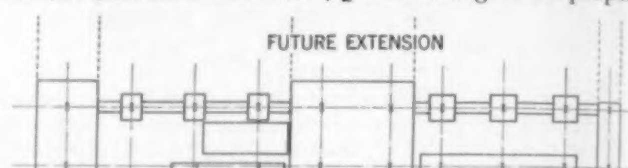


FIG. 6. FOUNDATION PLAN FOR SPREAD FOOTINGS

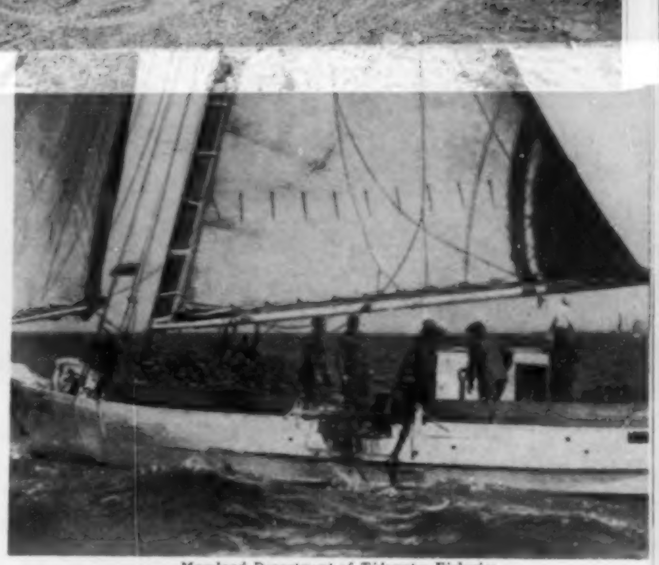
To provide for future construction, footings were extended beyond the limits of the first unit approximately to the center of the adjoining bay of the second unit, that is, to a point of zero shear. Provision was made for joining into future construction. This type of foundation was given preference over a continuous rigid or semirigid mat because of the extreme difficulties of analyzing and designing a mat for a structure of this areal extent, and because it was considered desirable to separate the turbine foundations from the building foundations to minimize the transmission of vibrations.

This design represents the final objective of the program of exploration and study. It provides an economical, usable foundation designed to fit existing soil conditions and to meet the requirements of the building it is to support. As of October 15, boiler and turbine foundations for the first unit have been completed and foundations for the structure proper are under construction.

The investigations that have been described were carried out with the assistance of the Engineering Department of the Bureau of Power and Light, City of Los Angeles, and thanks are due its personnel for their generous cooperation and for permission to publish the data and information contained herein.

Controlling Pollution of Oyster-Growing Waters of Chesapeake Bay

By George L. Hall, M. Am. Soc. C.E.
Chief Engineer, Maryland State Department of Health, Baltimore, Md.


Maryland Department of Tidewater Fisheries

Mechanical Dredge on Oyster Boat Is Worked with a Small Donkey Engine

Chesapeake Bay, extending 185 miles into Virginia and Maryland, constitutes a fishing ground known throughout the United States. Large portions of the population of Maryland and Virginia depend on this natural resource for income, and certain sections of the United States rely on it for seafood, such as oysters and other shellfish. In 1938, Chesapeake Bay produced an oyster crop amounting to $2,370,000 out of a total of $8,690,000 for the whole United States. Protecting these rich beds from sewage pollution is a problem of major importance to the population of our eastern seaboard, from the standpoint of both public health and economics. In this paper presented before the Sanitary Engineering Division at the Society's Spring Meeting in Baltimore, Mr. Hall tells why we can eat Chesapeake Bay oysters without fear of typhoid.

During the latter part of 1924 and early in 1925, excessive prevalence of typhoid fever was noted in Chicago, New York, Washington, and several other cities. Studies carried out by the U.S. Public Health Service, to determine the cause of this unusually high typhoid rate, indicated that the main factor in the spread of the infection was, beyond a reasonable doubt, the consumption of raw oysters. The report stated, further, that "The preponderance of evidence is that the general supply of no large distributor of oysters was uniformly infected, but that oysters infected in one or more beds or part or parts of one or more beds or at one or more floats, and constituting but a small proportion of the total, were introduced into and distributed with a large supply of oysters of good sanitary quality." ("A Typhoid Fever Epidemic Caused by Oyster-Borne Infection (1924–1925)," by Lumsden, Hasseltine, Leake and Veldie, Public Health Reports, Supplement No. 50.)

Wide publicity was given to the cause of this wave of typhoid and as a result the general public avoided oysters for a time. The oyster business in the eastern part of the country was practically at a standstill as there was very little demand for the product. Great financial losses were suffered by the oyster packers, and many of them were compelled to close. This situation required the application of effective remedial measures without delay to protect the quality of the oyster-growing waters and to restore public confidence in the industry. With the cooperation of the U.S. Public Health Service, closer control over the oyster waters in the United States was undertaken jointly by the several oyster-producing states and the federal government for the purpose of assuring the output of a safe product under proper sanitary control both in the growing areas and in the methods of handling and transportation.

Prior to 1925 the Maryland State Department of Health, through its Bureau of Sanitary Engineering, had carried on rather comprehensive surveys and sampling of a number of the oyster areas in Chesapeake Bay and tributaries, where it appeared possible that the water might become polluted by sewage discharges from nearby communities. No attempt had been made, however, to survey all the oyster-producing areas of the bay because of limited personnel and funds.

Following the typhoid outbreak and its effect on the Maryland oyster industry, a special appropriation was made available to the State Department of Health for extending its studies of the oyster-bearing waters and the shucking and packing houses in the state. The Department's Bureau of Sanitary Engineering was assigned the duty of sampling all oyster bars and the overlying waters and making the necessary surveys of adjacent land areas for the purpose of determining the areas from which the taking of shellfish should be prohibited. This work was started early in 1925.

The field work consisted of sanitary surveys to determine all possible sources of pollution within 100 ft of the water's edge and to investigate sanitary conditions in the towns bordering on these waters. The location of all sources of pollution, including sewer outlets and overboard privies, were indicated on maps prepared at that time. These maps cover the entire tidewater shore line of Chesapeake Bay and its tributaries to the upstream end of all oyster plantings and storage areas and show in addition the location of all the natural oyster bars. Information concerning the location of

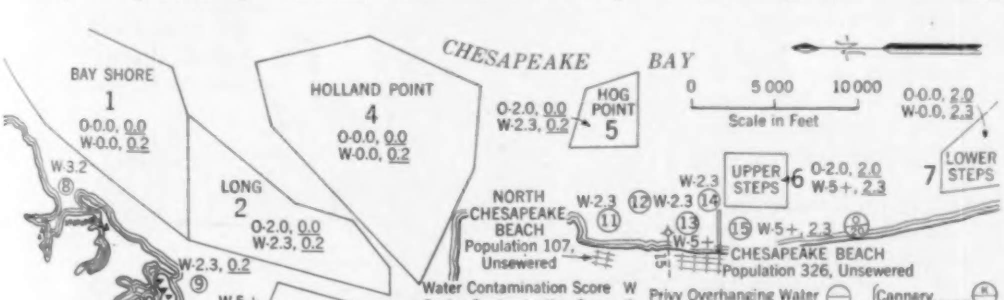


Fig. 1. Sample Map Dated December 1940, Indicating Polluted Areas in Relation to Oyster Beds, Shore Line, and Sources of Pollution

Maryland Department of Tidewater Fisheries

OYSTER DREDGING BOATS IN CHESAPEAKE BAY USE SAIL AS POWER IS PROHIBITED IN MARYLAND AND MOST OTHER OYSTER WATERS EXCEPT WHEN OYSTERS ARE TONGED BY HAND

the oyster bars was obtained from the Conservation Department of Maryland.

While the land surveys were under way, samples of oysters from the bars and samples of the overlying waters were collected for bacteriological examination to determine the effect of sewage and waste discharges. From the sanitary surveys and the bacteriological tests it was possible to establish the presence or absence of harmful pollution in the oyster beds. This sampling program has been continued up to the present time. Sampling is only done during the oyster season, which in Maryland extends from September through April, or during the "r" months. From time to time it has been found desirable to resurvey many of the shore areas covered in the original work as well as to survey new areas where population has become concentrated close to the shore. All data gathered from the sanitary surveys and from the sampling program are placed on the record maps which are prepared for each year's work. One such map appears in Fig. 1.

SAMPLING AND SANITARY SURVEYS COORDINATED

According to the latest figures available, there are in Chesapeake Bay and tributaries approximately 267,000 acres of natural oyster bars and 6,885 acres of water area leased by the Conservation Department for oyster propagation, or a total of 273,885 acres of oyster-bearing waters. Each year engineers of the Maryland Bureau of Sanitary Engineering endeavor to collect representative oyster and water samples from the entire area, with the exception of the bars in the Potomac River. These latter can only be reached with the aid of a floating laboratory, since they are too inaccessible to fit into our established sampling procedure. Since the beginning of the control program in 1925, over 25,500 samples of oysters and overlying waters have been collected and examined in the Bacteriological Laboratory of the State Department of Health. The analytical findings are reviewed critically in relation to the data from the sanitary surveys. The results have caused restrictions to be placed on 12 locations (Fig. 2) in the bay and tributaries, within the limits of each of which the taking of oysters is prohibited, because of present or possible future sewage pollution. The combined area of the restricted waters is only 0.6% of the total oyster-producing area in Chesapeake Bay, both natural and leased. Thus it may be seen that, at the present time, pollution is not a serious problem as regards extent of area affected.

In the bacteriological examination of each water sample, five 10, five 1, and five 0.1 ml dilutions are used. The results of the examination are expressed in terms of a "score," which is an indication of the density in the water of organisms of the coliform group. The presence of these organisms in each fermentation tube, if confirmed, is given a value which represents the reciprocal of the greatest dilution in which the test is positive. The addition of these values for the five fermentation tubes gives the total value for the sample, and this figure is the "score," the tube representing the greatest dilution for each set being counted.

A review of the published analytical findings of 1,446 water samples collected during 1939 from both the safe and the restricted areas in Chesapeake Bay, shows that

Maryland Department of Tidewater Fisheries

IN WINTER, OYSTERS ARE TONGED THROUGH THE ICE

81.4% had "scores" of 2.3 or under. This means that five 10-ml and two 1-ml tubes were positive for the coliform organisms. This "score" approximates the unofficial tentative standard of quality for oyster-growing waters suggested by the U.S. Public Health Service, which is that oysters for direct marketing should not be taken from waters in which more than 50% of the 1-ml samples are positive for organisms of the coliform group.

Of the 1,221 water samples collected during 1939 from the Chesapeake oyster areas, exclusive of restricted waters, 89.7% had scores of 2.3 or less, while 96.2% of the total number of samples, or 1,175, had scores not exceeding a value of 5.0. The effects of pollution in these waters at the present time, therefore, from a bacterial standpoint, do not appear to be particularly extensive or of great significance.

Improvements in the collection and disposal of sewage in those communities situated on the bay and tidewater tributaries during the 15-year period from 1925 to 1940 are worthy of mention. A number of sewage treatment plants were constructed in this period primarily for the protection of oyster bars in waters receiving raw sewage. An added incentive to such construction was the federal aid provided during the past eight years.

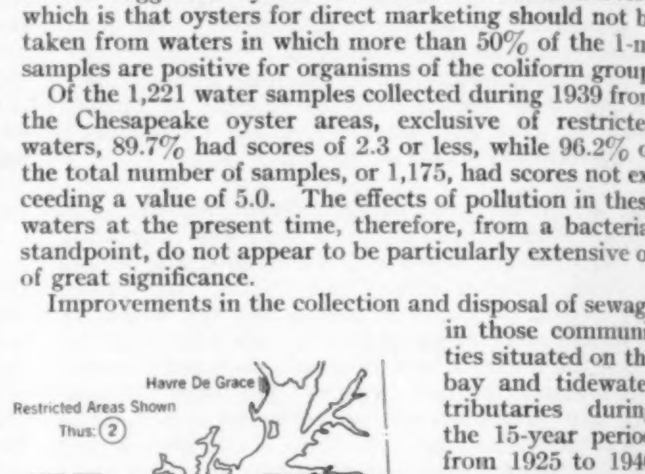


FIG. 2. UPPER OR MARYLAND SECTION OF CHESAPEAKE BAY Showing 12 Acres Where Shellfish Raising Is Prohibited

Maryland Department of Tidewater Fisheries

Spat or Young Oysters Attached to Oyster Shells in This Case Average 2,688 to the Bushel of Shell

Baltimore Evening Sun

Oyster Tonging Is Done by Hand from Small Power Boats

In 1925, about 1,376,000 persons residing in Maryland and in the District of Columbia were emptying into the waters of the bay 99 mgd of sewage. Of this amount 41.4 mgd, or about 42%, did not receive any treatment. The daily sewage flow reached a volume of 204.4 mgd by 1940 from a population of 1,762,000. Only 6.7 mgd, or 3.3% of the 1940 total daily sewage flow, was discharged into tidewater without having received treatment of some kind.

In 1940 there were 19 sewage treatment plants in the state, including Washington, D.C., discharging effluent into the tidal waters of the bay and tributaries. These plants treated an average of 197.7 mgd of sewage, as compared with 9 plants treating 57.8 mgd in 1925. The degree of treatment in use at present ranges from a minimum at Crisfield where the solids are comminuted and returned to the sewage, followed by chlorination and discharge into the Little Annemessex River, to complete treatment at the Back River sewage works of Baltimore City, where an activated sludge plant is operating in parallel with the older trickling filter works. At all treatment plants in proximity to natural oyster bars, continuous chlorination of the effluent is required by the State Department of Health to further protect the waters against harmful bacterial pollution.

Although there has been a creditable advance in Maryland in the installation of sewage treatment plants during the period from 1925 to 1940, there is no instance on record of any reduction in the limits of a restricted area because a nearby community has provided treatment for its sewage.

The wisdom of such a policy is readily apparent, it is believed, from two events that took place in the past few years. In one instance dredging operations resulted in the breaking of a 24-in. cast-iron under-water raw-sewage force main. This break allowed the discharge of approximately 2 mgd of sewage into the overlying waters for a period of several months before repairs were made. The under-water force main is in an area within which the taking of oysters is forbidden. The break was about 1,500 ft from the nearest oyster bar which is inside the restricted area, and about 6,000 ft from the nearer boundary line.

At another point where approximately 2 mgd of chlorinated sewage effluent is discharged into a restricted section of one of the larger rivers of the state, in the vicinity of many large natural oyster bars, there are periodic lapses in the operation of the sewage pumping station which allow raw sewage to be discharged close to the oyster bars.

In neither of these instances was any deterioration noted in the quality of the water beyond the limits of the existing restricted areas. These experiences tend to emphasize the fact that the possibility of sewage pollution reaching oyster-growing areas even after the installation of modern sewage treatment plants is still an element that must be considered.

STRICT CONTROL GUARDS HEALTH

The Maryland State Department of Health, since 1925, has exercised strict control over the quality of the oyster-growing waters of the state to assure the production of a safe food product. Regular sampling of the waters of the bay and tributaries where oysters are grown, is carried on systematically each year during the oyster season. Of all the sewage from cities and towns now discharging into tidewater, 96.7% now receives some form of treatment. There are still several towns emptying untreated sewage into the upper reaches of some of the tidewater streams but they are located anywhere from 12 to 35 miles away from the nearest oyster bar. Where sewage treatment plant effluents discharge into tidewater in proximity to oyster areas, chlorination of the effluent is required by the State Department of Health. As an additional safeguard to the ultimate shellfish consumer, the taking of oysters from waters in the vicinity of sewer outlets is prohibited.

In preparing this article, use has been made of the following sources: "A Biological Study of Offshore Waters of Chesapeake Bay," by R. P. Cowles, Fisheries Document No. 1091, U.S. Department of Commerce; 1933 Report of Water Resources Commission of Maryland; Statistical Bulletins Nos. 1361 and 1385, Bureau of Fisheries, U.S. Department of the Interior; and the annual reports of the Bureau of Sanitary Engineering, Maryland State Department of Health.

Maryland Department of Tidewater Fisheries

Tonging Boats Returning from Oyster Beds Often Tow One Another

Airport Planning for National Defense

Principles Governing Execution of Air-Force Expansion Program

By Edwin C. Kelton

Colonel, Corps of Engineers, U.S. Army; District Engineer, Los Angeles, Calif.

The part played by the airport in modern warfare is beginning to be clearly understood. To launch mass bombing attacks or to repulse such attacks with fighter squadrons requires ground facilities of appalling capacity. Consider the problem of fueling, loading, routing, and organizing waves of bombers several hundred strong. Such considerations give proper perspective to the problem. For maximum efficiency airports must be constructed and used during peacetime for private and commercial traffic as well as for military training. In this paper, delivered before the spring meeting of the Arizona Section, Colonel Kelton discusses construction requirements and the coordination of civilian and military authorities. In order to post the reader on new developments and changes, Colonel Kelton has reviewed the paper and made a few revisions as of October 1.

During the past twenty-five years, all phases of aviation have progressed steadily at an ever-increasing tempo. The greatest impetus to progress was provided by commercial development. However, in more recent years private flying has greatly expanded and this, with the present national emergency, has created an urgent need for aviation equipment and airport facilities of all types.

Everyone can remember the old landing fields of the barnstorming days, which usually consisted of idle farms, pasture lands, or public fairgrounds. With the advent of regular commercial service for passengers and mail, the first airports were established. These were usually privately owned and were haphazardly chosen with little thought of permanence or future expansion. Aviation at that time was in its experimental stage and was hardly considered a sound financial investment. Then came the municipally owned airports, with the demand for better and safer landing fields. All-weather fields with provision for drainage were required. Longer and wider paved runways, together with better hangar and ground facilities, and weather forecasting services, were demanded. Night lighting of fields, removal of flying hazards, and standardization and regulation of the airports by governmental agencies soon became essential.

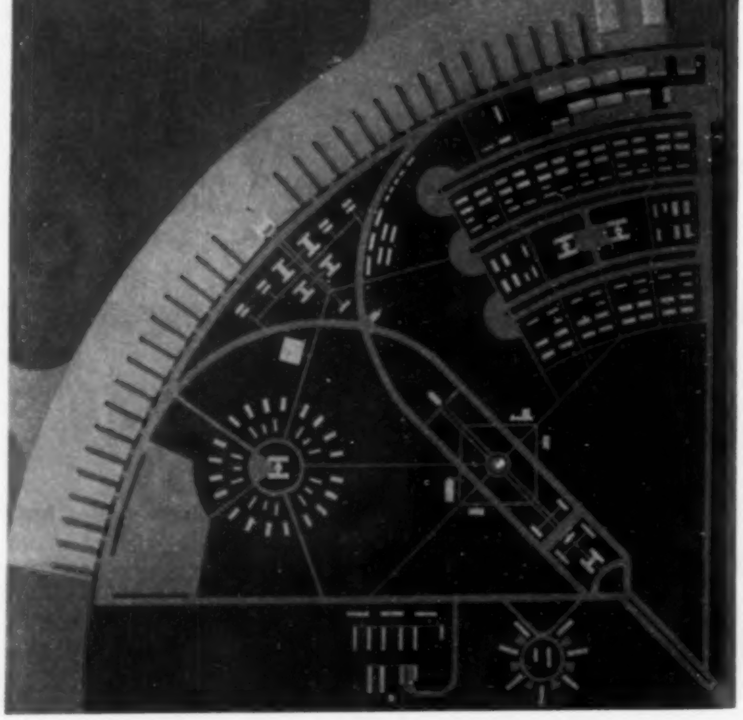
It is not the purpose of this discussion to present the historical background of aviation. However, I do wish to emphasize that, in airport planning as well as in other fields of engineering, the past record of successful or faulty engineering practices is a priceless heritage. Two of the most serious faults in former airport planning have been (1) inadequate provision for future expansion, and (2) inadequate or faulty drainage construction. Lack of proper drainage has all too frequently limited the usefulness of airports to dry periods and has no doubt been the greatest single factor in the deterioration and failure of runway pavements.

The present national emergency has necessitated the construction of numerous new civil and military airports and the expansion and improvement of many existing ones. The coordination of this work is the responsibility of a board consisting of the Secretaries of War, Navy, and Commerce. The control and regulation of civil airports is the responsibility of the Civil Aeronautics Administration of the Department of Commerce. Many of these C.A.A. airfields are now being adapted to military requirements as secondary or auxiliary fields for the use of the Army and Navy. In all cases, the selection of a new airport site for the C.A.A. is reviewed by a site board consisting of interested personnel of the three above listed Government departments. Site boards for new Army airfields will be discussed later.

At present the aviation element of the U.S. Army is designated as the "Army Air Forces." The "Army Air Forces" are divided into two principal branches—the Combat Command (the fighting units) and the Air Corps (pilot training and materiel).

The Combat Command is organized in four Air Forces or command units designated as the First, Second, Third, and Fourth Air Forces. Each Air Force consists of three major elements: Interceptor Command, with pursuit and fighter planes; Bomber Command and Support Command, which provide support for the Army's ground units such as observation, photographic work, parachute troops, etc. A fifth Support Command works with the new Armored Forces.

The Air Corps has two main divisions—



Model Layout for a Military Airport

training and materiel. The Chief of the Air Corps is responsible for the procurement, storage, supply, maintenance, and final disposition of military aircraft, accessories, supplies, facilities, and appurtenances used in connection therewith, including technical inspection, preparation of plans governing the construction of stations of the Air Corps and Army Air Forces; the command and control of all Air Corps stations and all personnel, units, and installations thereon, including station complement personnel and activities.

Typical Site for a Western Airfield
Cantonment in Background

An airport for either civil or military use must serve its primary purpose of providing a safe landing field from which aircraft may operate. In addition, supply and maintenance facilities are essential. Generally civil airports are located close to the cities they serve. The size of the airport is determined by the type and density of the traffic expected. This in turn is dependent on the population of the city and its supporting areas, on whether it is or is not on a commercial air line, and on the amount and type of private flying.

Smoothing the Site—Initial Operation in Western Airfield Construction

The Civil Aeronautics Administration's classification of civil airports is based on the following considerations:

1. Class 1 airports, which are designed to serve small communities not on an air carrier system. At sea level the length of runways varies from 1,800 to 2,500 ft, and airports of this size will handle only small equipment, usually privately owned planes.

2. Class 2 airports, which serve towns having populations from 5,000 to 25,000 on present or proposed feeder lines of the air carrier system. At sea level the required runway lengths vary from 2,500 to 3,500 ft. An airport of this size will accommodate large-sized privately owned planes and small transport planes.

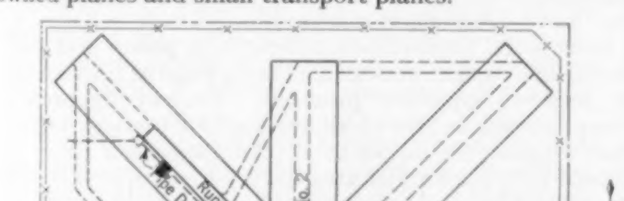


Fig. 1. Typical Airport Satisfying Civil and Military Demands, Municipal Airport No. 2, Tucson, Ariz.

3. Class 3 airports, which serve the larger cities on feeder lines or main-line airways. Runway lengths vary from 3,500 to 4,500 ft at sea level. Airports of this classification will adequately serve the commercial transports now in use.

4. Class 4 airports, which serve the largest industrial centers and the junction points of major air lines. Runways are 4,500 ft and over in length and must be designed for the largest planes in use. Such airports must also allow for the planes of the future.

The required length of runways increases as the altitude increases. This is due to the decreasing density of the atmosphere and a corresponding decrease in the lifting power of a plane. For a typical example, a 4,500-ft runway at sea level would be the equal of a 4,670-ft runway at an elevation of 1,000 ft and of a 7,120-ft runway at 10,000 ft.

Whatever the class of the airport, suitable provisions for expansion must be provided. In general, a Class 4 airport will require an area of one square mile. It is common practice to expand airports from Class 1 to Class 4 by increasing their size in $^1/_4$-sq-mile areas, in accordance with a comprehensive master plan prepared well in advance.

A military airport is defined as an establishment consisting of a landing field from which Army Air Force units may operate, and facilities for the maintenance, supply, and repair activities of the units. There are base and advanced airdromes, depending on their relative distances from the front lines. There are three general types of aircraft to be accommodated:

1. *Observation Aircraft.* These are based upon advanced airdromes approximately 20 to 70 miles behind the front lines. Additional advanced landing fields near the front will be required in wartime in order that observation (support) units may cooperate with and support combat units of other branches of the service.

2. *Interceptor or Pursuit and Light Bombardment Planes.* These are located in the same general area.

ROAD EQUIPMENT GRADING A MILITARY AIRPORT

However, these planes as a rule do not require advanced landing fields near the front lines.

3. *Medium and Heavy Bombardment Planes.* These longer-range planes of all types are based in rear areas on airports similar to those used in peacetime.

The sites for new military airports are selected by boards of officers appointed by the Adjutant General. The membership of these boards is made up of officers, including Air Corps officers, Medical officers, and Engineer officers, especially qualified for this duty. In addition to selecting the site, each board obtains the data necessary for the acquisition of the property by the U.S. Government and information for the War Department concerning the facilities available at the site. In selecting sites, it is necessary to take into consideration the facilities that ordinarily must be provided for the project, including water, gas, sewage disposal, power and telephone utilities, an all-weather road, and a right of way for a railroad spur. The board also generally prepares the original sketches showing the arrangement of runways and building areas and connections with highways, railroads, and basic utilities.

DESIRABLE FEATURES OF A BASE

Acquisition of property for military air bases is customarily accomplished through the cooperation of local agencies. Under favorable conditions, local facilities are adaptable and may be acquired on the basis of a yearly lease at a nominal rental with an option of renewal for 25 years. Desirable features of a suitable base include water, gas, power and telephone lines to the boundary of the site; accessibility to a railroad, either a spur or a main line, for the transportation of fuel, equipment, and supplies; and a paved two-lane highway to the site. Where these features are not a part of existing facilities, the willingness and ability of local agencies to provide them frequently permit the adoption of a site which otherwise would have to be abandoned because of excessive costs to the Government.

In general an airport requires 640 acres, or one square mile of land. The building area for a force of about 3,000 men should be approximately 160 acres, with sufficient adjacent area to accommodate 100% expansion if necessary. The land should be reasonably flat and free of vegetation, requiring a minimum amount of grading. It should be well drained and have a low subsurface water level. The site should include no public highway or railroad right of way, and should be free of houses, barns, windmills, gas lines, power lines, and other obstructions. The area should also be free of all mineral rights, or there should be a satisfactory waiver of such rights to render them inoperative during the tenure of the lease.

Every detail of the layout must be subjected to careful scrutiny from the point of view of flying safety, and no considerations of convenience, design, or expediency can justify the inclusion of elements that might constitute hazards to the flying personnel. The first unit to be designed is the flying field itself, which may be covered all over with turf or provided with paved runways. The general layout of the field, and the direction, location, and dimensions of runways will usually be determined by the board of officers that selects the site. Their determinations are based on the directions of the local prevailing winds, the terrain, aerial obstructions in the neighborhood, characteristics of soil and subgrade, and requirements of airplanes to be accommodated.

REQUIREMENTS FOR RUNWAYS

The minimum runway length for military airports is 4,500 ft for sea-level conditions. Correspondingly greater lengths must be provided at increased elevations as mentioned previously. The width of runways is 150 ft for bombardment group operations and from 150 to 300 ft or more for pursuit groups and school installations. Runways should be sufficient in number to permit takeoffs and landings to be made within $22^1/_2°$ of the true wind direction for 90% of the time. In general the maximum grade, longitudinally and transversely, for landing strips, runways, taxiways, and aprons should not exceed 1%. Every runway should be graded so as to permit an unobstructed view of the entire length from the pilot's eye level (about 10 ft above the surface) at any point along the runway. Grade changes must be gradual, not exceeding one-half of 1%.

In the turf areas bounded by runways and taxiways, and in the areas immediately outside the runways and taxiways, steep grades should be eliminated. In order to permit takeoffs and landings across the intermediate areas, the field grade in any direction should not exceed 1% in general. Runway and landing-strip longitudinal intersection grades should be joined by vertical curves at least 500 ft in length. The longitudinal tangent interval between vertical curves on runways should be not less than 1,000 ft where practicable.

Such aerial obstructions as buildings, power and telephone lines, and towers on land bordering the field should be removed wherever practical. Runway "approach zones" should be free of all vertical obstructions higher than a glide ratio of 40 to 1. An "approach zone" is defined as a trapezoidal area having a width of 1,500 ft at the end of the runway and broadening to 3,000 ft at a distance of 1,500 ft from the runway, the center line being a continuation of the center line of the landing strip. Adequate zoning ordinances must be adopted for land surrounding the airport to prevent the construction of flying hazards. The Chief of the Air Corps prescribes that no building shall be built within 750 ft of the center line of a runway.

The drainage system must prevent flood waters from entering the field from upstream watersheds. Such waters are usually prevented from entering the field by open diversion ditches or low levees bordering the airport. The grading plan must provide for the rapid removal of surface runoff from runways, aprons, and taxiways, and the collection and removal of these waters by an underground drainage system. Runways and connecting taxi strips should be usable under all weather

Every Military Airport Requires a Service Cantonment
Construction Views, "Somewhere in the West"

conditions. The required drain capacities are usually determined by the "rational method," using a one-hour intensity rainfall with a frequency of 1 year in 10. Subsurface drainage is required when the water table is high and subgrade bearing capacities are poor. The exact location and spacing of subsurface drains are dependent on the character and permeability of the soil. The relative drainability of the soil should be determined by laboratory tests.

Military and commercial aircraft now in operation vary in weight from 1,000 to 164,000 lb and their weight is generally distributed on two wheels. The Douglas B-19 has a gross weight of 164,000 lb, and present trends indicate that greater weights might be anticipated. It is probable, however, that these greater loadings will be distributed on four wheels, to result in a wheel loading not in excess of 82,000 lb. This figure is now being used in the design of airport pavements and special structures at some of the fields. Recent investigations have demonstrated that dynamic or impact loads are quite small during normal landings. An increase of 25% is believed sufficient to allow for this factor.

TYPES OF RUNWAY PAVEMENTS

Selection of the proper type of runway pavement depends on the size, type, and density of anticipated traffic, and on subgrade bearing capacity, availability and cost of construction materials, local conditions, the kind of construction equipment available, and the probable life and future use of the airport. Careful field and laboratory investigations should be conducted to determine the subgrade bearing capacity, the permeability of the soil, and the availability and cost of construction materials.

The types of runway pavements now in use are turf, sand-clay, gravel, oyster shell, bituminous soil stabilization, soil cement stabilization, macadam, lime-rock, lean-mix rolled cement concrete, cement concrete, asphaltic concrete, bituminous surface treatment, and metal grid runways. Each type has its use, its advantages and disadvantages. Selection of the proper type for a given site should only be made after a very careful consideration of all factors. The type of buildings required in airport construction depends on the size and type of the airfield. In general the buildings now being constructed are of temporary, standard design type. They include administration buildings and control towers, hangars and repair shops, barracks, mess halls, school buildings, recreational facilities and buildings, chapels, hospital, warehouses, technical buildings, utilities, and service facilities.

The water supply system must be adequate to provide for domestic purposes, fire protection, and the Air Corps gasoline fueling system. The water supply very often has to be developed from wells or transported from streams or lakes. The domestic supply is based on 100 gal per capita per day, with provision for a 50% increase in personnel. An elevated storage tank having a capacity of one or two days' normal consumption or four-hour fire demand is provided for emergency use. A typical Air Corps gasoline fueling system requires approximately 2,000 gal per min for short periods at a normal pressure of 35 lb per sq in. at the storage tanks.

Coal, fuel oil, natural gas, butane gas, and electricity are the fuels generally considered for heating and cooking. The final selection is based primarily on cost and availability.

The sewage disposal system is designed for a capacity of 70 gal per capita per day. A treatment process of proved merit is chosen after a thorough study of all governing factors. Again there is a sharp peak-load demand not encountered in municipal design practice.

Adequate electrical installations must be made for the normal lighting requirements of the cantonments—night field lighting, repair shop equipment, and utility installations. Standby units are required for the operation of all essential services. Night field lighting equipment includes boundary lights, contact lights, obstruction lights, range lights, taxi lights, lighted wind cones or tees, rotating and code beacons, and signal lights on control towers.

Since its inception more than a century ago, the Corps of Engineers has been charged with the duty of providing adequate communication routes for the armed forces of the United States. Engineer forces in war zones have always had to provide and maintain roads and railroads, with the necessary bridges to meet the tactical and logistic requirements of the infantry and artillery. Similar services are now being rendered the Air Corps by providing airfields and their access roads. The district offices of the Corps of Engineers are now engaged in a program of constructing large military air bases for mobilization and training purposes. These airports will serve as base airdromes in time of war. In addition to the strictly military airports being constructed, a large number of municipal airports throughout the nation are being developed on a lease basis as military stations and improved under the Civil Aeronautics Administration development program. The latter airport improvements are also being constructed by the Corps of Engineers and coordinated with military defense requirements. With the splendid cooperation of local officials and contractors, rapid progress has been made to date.

In time of war, however, quickly prepared advance airfields are essential to meet shifting battle conditions. These landing fields will provide only fuel and ammunition dumps so that airplanes stationed there for short periods can be resupplied quickly after each mission. Aviation engineer battalions and regiments are now being organized, equipped, and trained for this duty. One of these is now in southern Alaska putting in two very important intermediate landing fields and staging areas. Others will soon take their places in providing "communication" for our fast-growing army.

Boulder Transmission Line Utilizes Poured-in-Place Foundations

By K. A. Reeder, M. Am. Soc. C.E.

Structural Engineer, Southern California Edison Company, Los Angeles, Calif.

Two important transmission lines were built by the Southern California Edison Company to transmit energy from the Government-owned hydroelectric station at Boulder Dam to the company's distributing center at Chino, Calif. Both are 220,000-v lines supported on steel towers approximately 234 miles in length and roughly parallel. The No. 1 line has footings of the conventional type while the No. 2 uses the novel type described by Mr. Reeder in this paper, which was originally presented before the Soil Mechanics and Foundations Division at the Society's Convention in San Diego. Cost records and performance tests as well as speed in construction prove the worth of this new departure in tower foundations.

To conduct power from Boulder Dam to its distributing center at Chino, Calif., the Southern California Edison Company has built two transmission lines, which are very similar except for the tower foundations. For purposes of identification in this paper they are numbered 1 and 2. Line No. 1 was completed in 1938 and line No. 2 will be energized within the year 1941. The route and profile of these lines are shown in Fig. 1.

Upon leaving Boulder, they follow along the eastern slope of the Black and McCullough Mountains on the alluvial fans and outwash of these ranges, cross the McCullough range at Nipton Pass at an elevation of 5,000 ft above sea level, and enter California approximately 49 miles from Boulder. From the Cima summit, El. 4,800, they gradually dip into the desert and wind-blown sand regions of the Devil's Playground, cross extensive lava beds near Pisgah, and follow along the north slope of the San Bernardino Mountains. At Cajon Pass the lines cross the San Andreas Fault, and from the summit of the San Bernardino Mountains drop abruptly into the orange groves and vineyards of San Bernardino County to their terminus at Chino.

The towers of line No. 1 are supported on pyramid-type steel footings. This type of footing, shown in Fig. 2, was up to 1938 a standard design of the company and was used on all lines and locations except where tests indicated that the soil was severely corrosive. For such locations, a special type of concrete footing was used.

Shortly after the completion of line No. 1 the company became interested in a new type of footing. This may be described as a concrete cast-in-place pile or post. The construction is simple—a hole of predetermined diameter and depth is bored in the soil by mechanical means and filled with concrete carefully placed and thoroughly vibrated so that the concrete is in intimate contact with the soil. No forms are used except above ground. The concrete is reinforced to resist bending and uplift stresses, and the tower leg is bolted to a suitable connection embedded in the concrete.

In excavating for the pyramid-type footings used on line No. 1, a great variety of soil materials and conditions were encountered. It became evident that a more comprehensive knowledge of the material existing along the proposed line No. 2 would prove valuable as basic data for the study of other types of footings than the structural steel type. Accordingly, before line No. 2 was commenced, the company retained the services of R. V. Labarre, M. Am. Soc. C.E., consulting foundation engineer of Los Angeles, Calif., to make a comprehensive investigation of the topographical and geological peculiarities of the right of way and to develop the possibilities of cast-in-place piles as an economical substitute for the type of footing that had been used on line No. 1.

Cast-in-Place Piles Found Practicable

Early in the reconnaissance it became apparent that concrete foundations of the cast-in-place pile type might be very advantageously used, provided the holes could be bored by mechanical means in the coarse detrital outwash and fan material predominating over the larger portion of the line; that these bored holes would remain standing without caving for a reasonable length of time; and that a satisfactory aggregate could be located within

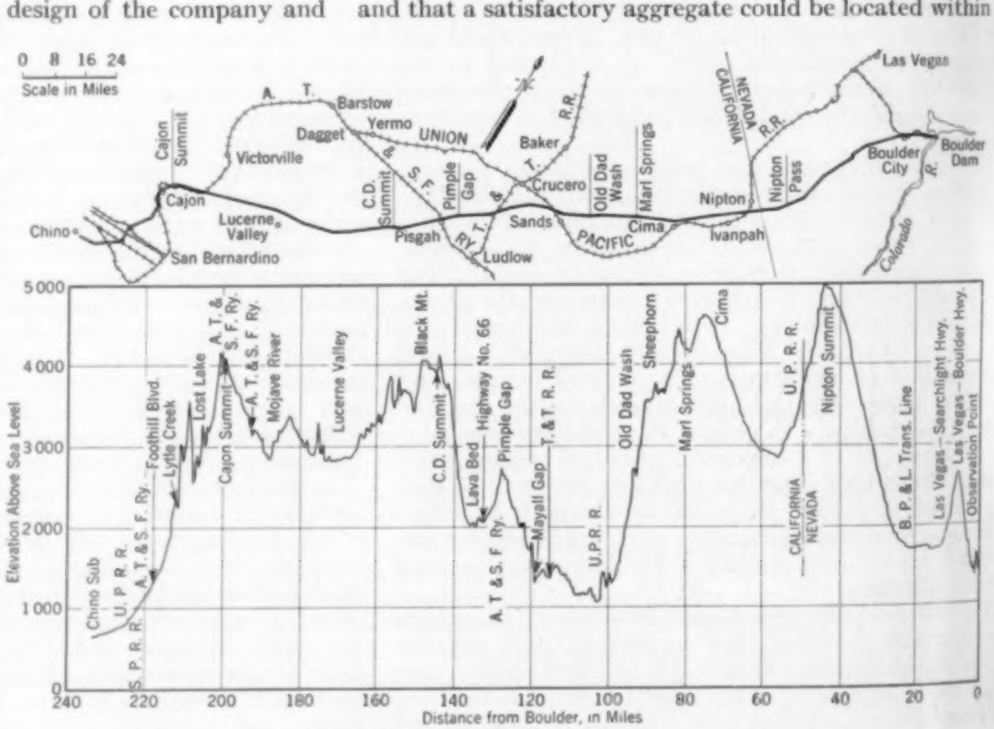


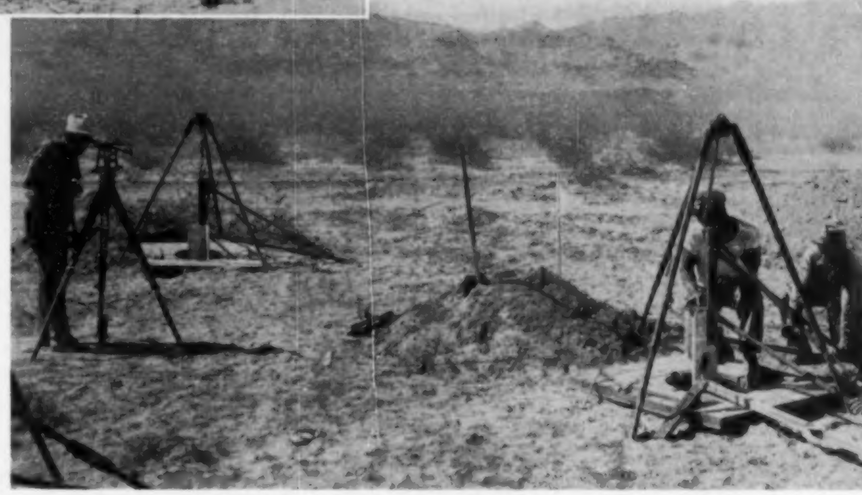
Fig. 1. Plan and Profile of Boulder-Chino Transmission Lines

(Left) Rotary-Bucket Drilling Rig Mounted on Light Truck for Easy Transportation

To Forestall Caving Near the Surface, Drilling Was Done Inside of Split Sheet-Metal Collars Embedded in the Sand

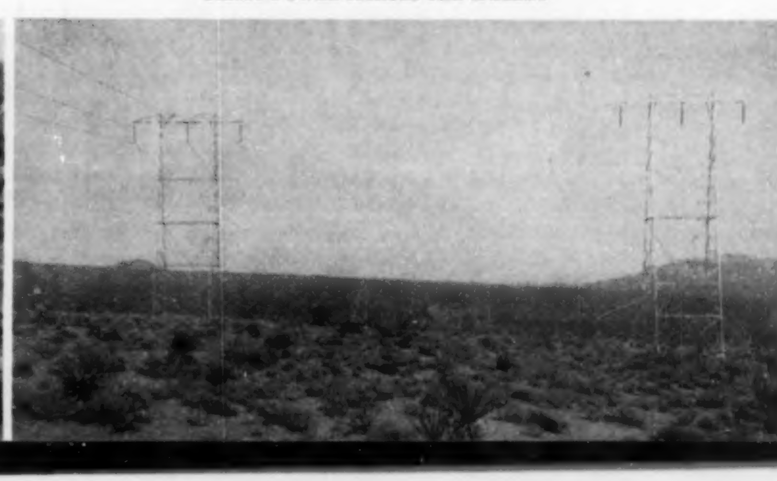
(Left) Pole-Hole Drilling Rig Was Used in Locations Where Suitable

Reinforcing Cage Being Placed by Improvised Stiff-Leg Derrick Mounted on a Light Truck



Stub-Angles Were Accurately Set So That Tower Legs Could Be Bolted Directly on Them

Concrete Was Poured from Truck-Mounted Mixer Plant



No. 1 Line (Left) and No. 2 Line (Right) Carry Power Across the Desert

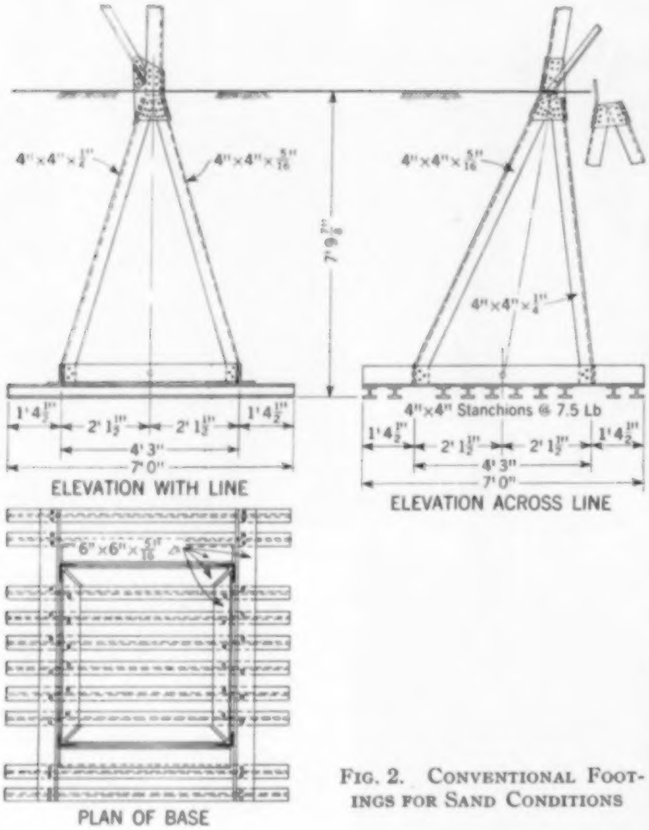


Fig. 2. Conventional Footings for Sand Conditions

economic hauling distances. With this in mind the reconnaissance was extended to include the detail classification of soil areas, and the location of possible sources of aggregate.

As the alluvium and outwash varied greatly in character on different sections of the line, each general section was considered to require investigation to determine the susceptibility of the material to drilling by mechanical means and its behavior under the loads to be imposed. Since the change in the character of the soil between sections was found generally to be a gradual one, it was necessary to cast the test piles where conditions were representative of the entire section.

All borings were made with a power drilling rig, using an 18-in. bucket, which in many cases in loose alluvium made an oversize hole varying in diameter from 18 to 20 in. The final depth of each hole was determined as the drilling progressed, the depth generally being governed by the type of materials encountered. The concrete test piles were made with aggregate procured as near as possible to the test location. In order to expedite the tests, quick-setting cement was used and the quantity was largely governed by the character of the aggregate—varying from $4^1/_2$ to $5^1/_2$ sacks of cement per cu yd of concrete.

PILES TESTED FOR UPLIFT AND HORIZONTAL FORCES

After all the test piles had been poured, they were tested for resistance to uplift and horizontal forces only, it being assumed that if they could resist the design uplift forces imposed, they would be equally capable of supporting the downward forces. As shown in Fig. 3, the uplift forces were applied by calibrated lifting jacks acting at one end of a lever, the other end being supported by a frame resting on the ground. The lateral force was applied by the same type of jacks bearing against a "deadman" and against the side of the pile near the top. It was felt that the stresses produced in the ground by the lever reactions were sufficiently remote from the pile to be disregarded. The results of these tests are believed to be truly indicative of the behavior of the piles under actual working conditions.

The loads were applied in increments and a record was made of the movement at each increment. To obtain a record of the recovery of the pile upon release of

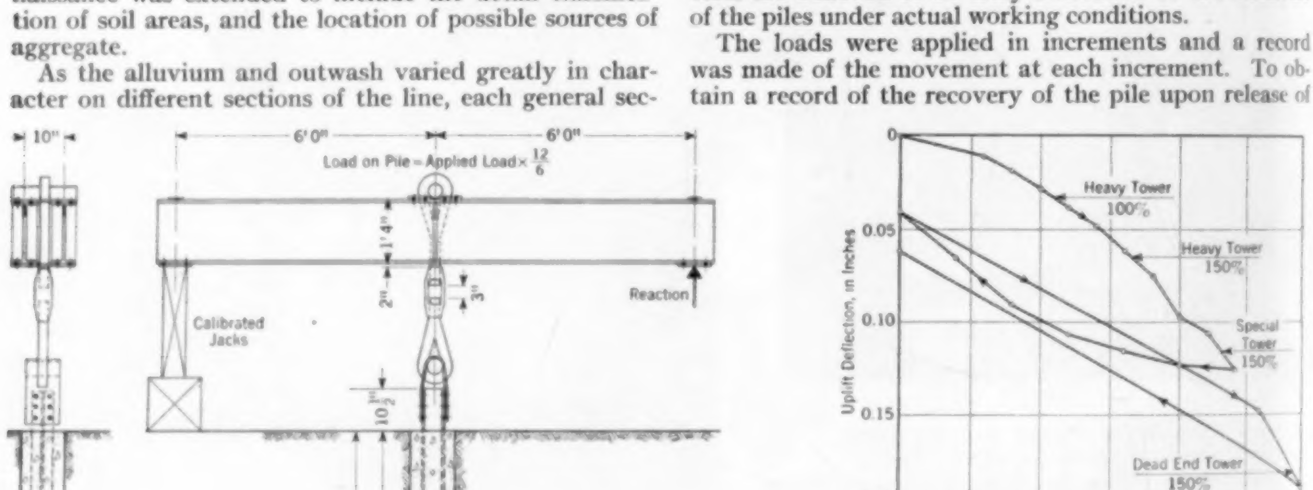


Fig. 3. Concrete-Pile Test Set-Up and Curve

the load and to determine the permanent set, if any, the final test load was released slowly and the recovery of the pile recorded. A typical test curve is shown in Fig. 3.

These tests indicated that it was possible to design and construct economical cast-in-place concrete piles fully adequate to resist 150% of the maximum working loads with a safe permissible deflection of $^1/_{10}$ in. The test data were therefore used for the final design of the pile footing. For each of the 15 piles tested, the experimental data differed materially, a fact that emphasizes the impropriety of applying these data elsewhere.

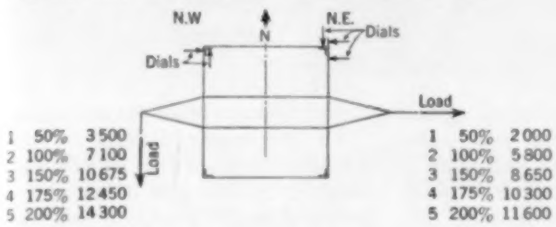


FIG. 4. RESULTS OF ACTUAL TEST LOADS APPLIED TO A TOWER ON CONCRETE PILES

In the design, the direct uplift and downward forces are resisted by the friction at the contact of the pile with the surrounding ground. For the downward force the bottom area of the pile provides additional resistance. This was neglected in the design. For the horizontal forces acting at the top of the pile, the stresses set up in the pile are those of moment and shear, and the external resistance is provided by the soil.

ASSUMPTIONS USED IN PILE DESIGN

Pile design was based on the following assumptions: (1) that the deformation of the pile relative to that of the soil is negligible, which means that the pile may be treated as a rigid body, and (2) that the force required to produce a unit lateral deflection in the soil varies directly with the distance below the surface, and hence that the soil pressure acting at any point on the pile is a function of the depth below the surface and the deflection at that point.

Under these assumptions, the pile will tend to move in the direction of the load at the surface of the ground and in an opposite direction at its base, the soil forces on the pile being distributed as a parabola. Formulas were derived for maximum soil pressures and bending moments. Horizontal soil forces on the test piles at deflections of 0.1 in. as computed from these formulas were found to vary from 3,700 to 14,000 lb per sq ft. Values of contact friction between the piles and the soil under uplift forces were also computed from the test data and were found to vary from 930 to 2,200 lb per sq ft of contact area. The values obtained from the test pile in any one section of the line were used in the final design of the footings in that section.

In order to test the sufficiency of the pile footing design under actual load conditions before adoption of the final design, a set of footings was designed for a light-loading suspension tower. An actual tower was erected on these footings and loads corresponding to wind load, broken-wire conditions, weight of conductors, hardware, and so forth, were applied to the cross-arm by means of cables to which chain blocks were attached. The loads were indicated by dynamometers. Dial indicators reading to 0.0001 in. were set up in contact with a connecting angle at the top of the footing and supported by a framework independent of the ground surrounding the footing. Enough indicators were used to measure vertical movements, horizontal movements in two directions, and any twist in the footing. The result of this test is shown in Fig. 4. It will be noted that the deflections under 150% of the maximum working loads are well below the 0.1-in. maximum movement, the criterion on which the design was based. The text was carried to 200% of the maximum working loads, and even at this extraordinary load the deflection did not exceed 0.18 in.

Upon completion of this test the design of the actual footings was commenced. As there were four types of towers in the line, it was necessary to make four footing designs for each section of the line. In Fig. 5 is shown a typical cast-in-place pile with reinforcing and connection stub-angle. Table I gives 150% design loads for each type of tower and the maximum and minimum footing dimensions for the various types of towers.

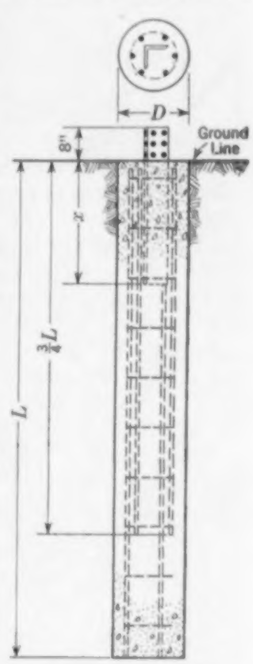


FIG. 5. TYPICAL CAST-IN-PLACE PILE WITH REINFORCING AND CONNECTION STUB-ANGLE

The Stone and Webster Engineering Corporation was awarded the contract for the construction of the line, and commenced excavation for footings in July 1940 using two truck-mounted, rotating-bucket, drill rigs. This equipment proved to be very satisfactory for more than 80% of the area. The diameters of the piles as designed were 18, 24, 30, and 36 in., these being the sizes of available drilling buckets. In order to speed up the work of excavation, one of the Edison Company's truck-mounted, pole-hole drilling augur rigs was used in such locations as were suitable for this type of machine. In approximately 15% of the tower locations it was necessary to resort to light blasting and excavating by hand. In the Devil's Playground area, where the soil material consists of wind-blown sand, it was necessary to stabilize the material by jetting water from tank trucks prior to and during the drilling operation. To retain sand near the surface, drilling was done inside of split sheet-metal collars embedded in the sand. No extraordinary difficulties were encountered in the course of placing the reinforcing steel and concrete or in setting the stub-connection angles.

TABLE I. FOOTING SIZES AND DESIGN LOADS (LB PER SQ IN.)

Types of Loading	Design Loads on Footings, Plus 50%			Sizes of Footings			
				Minimum		Maximum	
	Compression	Uplift	Hor. Shear	Dia.	Length	Dia.	Length
Light loading, suspension tower	50,500	47,000	12,500	18"	10'	24"	22'
Heavy loading, suspension tower	92,000	65,000	18,300	18"	10'	30"	15'
Special loading, tower...........	133,500	91,500	23,400	18"	10'	36"	24'
Dead-end tower...	133,000	117,000	35,200	18"	12'	36"	22'

Cost data are available at this time for the Nevada section of the line and they show a saving of 38% in favor of concrete pile footings over the steel pyramid footings used for line No. 1. It is sufficient to state in conclusion that the cast-in-place concrete pile has met all requirements in full-scale tests and under actual loading conditions, and has resulted in a considerable economy in footing costs.

Don't Hit Timber Piles Too Hard

By T. C. Bruns, M. Am. Soc. C.E.

Lieutenant Commander, Corps of Civil Engineers, U.S.N.R.; Chief Engineer, Lafitte Housing Project, Housing Authority of New Orleans, La.

To anyone who has driven piles and then had the opportunity to view them later, this paper will have an especial appeal. Although it deals directly with timber, similar results are obtained with steel and concrete. To prove it, one has but to pull the pile and observe the result, or in the case of sheet piling, one has but to dig out alongside it and explore the battered pile ends. Such evidence will give the field man a healthy respect for our modern pile-driving equipment and will show the futility of excessive driving. This paper by Lt. Comdr. Bruns was delivered before a joint meeting of the Louisiana Section of the American Society of Civil Engineers and the American Society of Military Engineers in New Orleans, La.

Naturally the admonition, "Don't drive timber piles too hard," immediately raises the question, "What is too hard?" The problem depends on so many variables that there is today no definite answer. Among the variables are the nature of the soil strata penetrated, the species and density of the timber, its greenness, the number and location of knots or crooks (especially in the lower 10 or 12 ft), and if pine whether turpentined or not. Even in quantitative terms the writer does not pretend to have an exact answer. However, he does give some "don'ts" and limits, which if followed will go a long way toward eliminating foundation troubles caused by the too-hard driving of piles. The advice here given is based on the most extensive tests of this sort ever carried out in the South. Eighty-eight test piles were hit with various degrees of punishment and then immediately pulled so that the damage to them could be observed. To follow the "don'ts" based on this experience will cost a ridiculously small amount in terms of percentage of cost of the building or structure whose safety is thereby insured.

The Lafitte Avenue Housing Project, in connection with which these tests were made in the early summer of 1940, consists of an administration building and 77 two and three-story buildings, comprising 900 apartments. It is located between Orleans and Lafitte avenues and is two blocks wide by eight blocks long.

To explore the subsurface conditions, 14 test borings of the core type were driven. Further investigation was made by driving and then immediately pulling and observing a test pile at the site of every building. Also five piles were driven and subjected to load tests. For driving the test piles we used a single-acting steam hammer (total weight 10,000 lb) with a 5,000-lb ram dropping 36 in.

After the proper pile lengths had been determined from the data thus collected, untreated Southern yellow pine piles were ordered and 8,000 of them were driven by usual methods, with a standard New Orleans turntable rig. The hammer used for the foundation piles was one of the new double-acting ones, with a 5,000-lb mechanical ram, which proved entirely satisfactory. An average of 95 piles, including 5 ft of following, were driven per 8-hour shift. Both the test piles and the foundation piles were driven by the general contractor, the R. P. Farnsworth Company of New Orleans.

Of the many different types of foundation piles now in use, the untreated timber pile is the cheapest, and naturally it is used wherever it will do the job. The thing that keeps it from doing the job is that it rots unless it is at all times under water. In New Orleans the ground-water level is so high that foundation piles are always under water and therefore the untreated timber pile is used there almost without exception. And it was of course used exclusively on the project here described. However, the experience gained from these tests might well be applied to creosoted timber piles, which some city building codes permit above the ground-water level. Other compromise piles for low-level ground-water conditions are the composite type.

Piles may also be classified according to the nature and stratification of the ground into which they are driven, as end-bearing, skin-friction, or a combination of the two. According to this classification, the 88 test piles driven on the Lafitte Avenue Housing Project come under the head of the combination type. The top 20 ft at this site consists of very soft wet gray clay and humus, which the piles penetrated under the weight of the hammer alone. The next 20 ft is sandy clay without very great resistance, which the piles penetrated at the rate of about 6 in. to the blow. The tip of the piles then came to rest on a hard-packed layer of sand, into which we permitted a penetration of only 3 or 4 in. Although of the combination type, these piles lean decidedly toward the end-bearing side of the classification.

This brings us to the salient point brought out by the test piles driven and pulled on the Lafitte Avenue Project. It is evident that the skin-friction type is in little if any danger of being broken or broomed. It is

Fig. 1. Two Hundred 1/2 to 3/4-In. Blows with a Heavy Hammer Did This to a Pile After It Reached Hard Sand Stratum

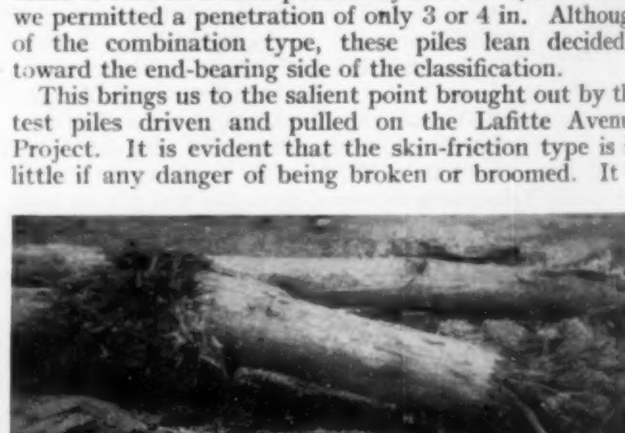


Fig. 2. Sixty Blows, 1/2 to 3/4 In., Broke This Pile; Driving Was Continued Until It Had Been Broken Twice Again

FIG. 3. SLIGHT BEND 4 FT FROM 6$\frac{1}{2}$-IN. TIP CAUSED THIS BREAK

equally evident that, with the end-bearing type, the minute the tip has reached rock or hardpan, further driving will either broom or break it. However obvious this conclusion is, there are many engineers and architects who consider that the combination-type pile is in no danger of brooming or breaking under hammer blows after it reaches the end-bearing stratum if it is still traveling, say, a half-inch to the blow of the 5,000-lb ram. The tests here described show, however, that the danger under these conditions is very serious. In fact, great caution, judgment, and experience must be exercised to guard against it. The accompanying photographs show what can happen to the tip of a timber pile while it is still traveling at the rate of half an inch to the blow. Figures 1 and 2 show that a timber pile may break several times under continued driving after the tip has reached a hard stratum. Also, pile weaknesses such as a slight bend, knots, or small tips will cause damage (Figs. 3, 4, and 5). Evidence that a pile with a larger tip will take more punishment is presented in Fig. 6.

The danger to timber piles from overdriving is recognized by many experienced men in this type of work. As evidence of this fact the writer presents quotations from several letters he received about a year ago at the time when he undertook the preparation of this paper.

"As you undoubtedly know, piles break below the ground while being driven primarily because of the amount of driving done on them but also because of the character of the material in which they penetrate, the kind of wood in the piles, and so forth. If the ground is very soft, down to a hard stratum, the points will undoubtedly break more easily than if they are driven into fairly consistent bearing material.

"In general the answer is not to overdrive the piles and not to overload them. The fact that they may break in driving is one of the reasons why they cannot be counted on for high loads, and the difficulty usually arises from the valient efforts of the inspector to have the piles driven 'just a little harder.'"—J. W. Taussig, M. Am. Soc. C.E., Vice-President and Director, Raymond Concrete Pile Company.

In the opinion of N. E. Lant, M. Am. Soc. C.E., Chief Bridge Engineer of the Louisiana Highway Commission, the important variables affecting the amount of punishment a timber pile will take are:

"1. Species of timber, that is pine, cypress, gum, etc.

"2. Condition of the tip and butt of the pile. What I have in mind here is that piles which show a great number of knots in the lower 10 or 12 ft next to the tip will not stand as much driving as a clear pile; also if pine piles are used that have been cut from turpentined trees, the butts are likely to be unusually hard and brittle."

It is also of much interest to note that in his letter Mr. Lant says that for the past six or eight years his department has been prohibiting the use of a 5,000-lb ram where there was any indication that hard driving would be encountered. The idea here is that nursing the pile down with a light hammer will not break it whereas the heavy blows of the 5,000-lb ram dropping 3 ft will. The writer's experience leads him to concur with this view.

Another interesting letter came from H. A. Christie, Project Manager of the Raymond Company, builder of the Ponchartrain Seawall, and the Watson Williams Bridge in New Orleans.

"During the past 20 years I have had a number of arguments in regard to how much driving an ordinary Southern pine pile will stand and it is my opinion that you cannot safely drive an ordinary Southern pine pile having a 6-in. tip and a 12-in. butt to more than $\frac{1}{2}$ in. per blow with a 5,000-lb ram dropping 36 in."

Evidently there are many variables that affect the amount of punishment a timber pile can take and these variables are of an elusive nature, including knots, bends, density, degrees of greenness, nature of material driven into, and its stratification. Therefore it is difficult to give any numerical answer as to the point at which timber piles will broom or break. However, until a great deal more research has been performed on the subject it would seem wise to back Mr. Christie's half-inch per blow and to adhere to it as an upper limit. It is further suggested that if the tip of the pile is in material containing sand, shell, or gravel, a minimum of this sort of driving be done to the pile.

There are two further "don'ts" which should be pointed out as a result of tests here described:

1. If a condition is encountered where the tip of the pile will be brought up on a hard stratum entirely overlain by soft material, don't buy piles with 6-in. tips; buy them with 8 or 9-in. tips if it is at all possible, and see to it that they are as free as possible of knots and bends in the lower 12 ft. And don't keep pounding them after they have reached the hard stratum.

2. If a condition is encountered where a hard stratum yielding, say, $\frac{1}{2}$ to $\frac{3}{4}$ in. per blow under a 5,000-lb ram, is overlain and underlain with soft material, and it is desirable to penetrate the upper stratum and land on a still lower hard stratum of greater thickness, again don't buy 6-in. tip piles but endeavor to secure larger piles as free as possible of knots and bends in the lower 12 ft. Even then don't use these stronger piles until several test piles have been

FIG. 4. KNOTS NEAR END OF THIS PILE CAUSED BREAK SHOWN IN LOWER PHOTOGRAPH

driven through the upper hard stratum, through the underlying soft material, landed on the lower hard stratum, and then pulled to definitely demonstrate that this penetration can be effected without breaking the piles. Otherwise it may appear that the pile has landed on the lower stratum when in reality it is broken and the splintered point has come to rest on the upper stratum. If these test piles do show any question marks and jetting is undesirable, it is best to forget timber piles and resort to one of the concrete or steel types.

FIG. 5. THIS BREAK OF A SMALL-TIP PILE OCCURRED IN FIRST THREE OR FOUR 1/2-IN. BLOWS AFTER IT HAD REACHED THE SAND STRATUM

Now in conclusion a general pile-driving principle should be restated: Don't consider the spending of increased money to increase pile strength or length as an increase in the building cost, but consider it simply as good insurance.

It is just as bad to have a building cracked or damaged by settling as by a tornado. Almost invariably when the additional cost of taking the question mark out of a pile foundation is calculated it is found to be a very small percentage of the total cost of the building. For instance, on the Lafitte Avenue Housing Project, when we questioned the ability of the upper hard stratum to carry the load, we drove through it using piles with a tip 9 in. in diameter, and added 10 ft to their lengths so as to land them on the thicker and more solid lower stratum. This added $172 to the cost of a $60,000 building, which

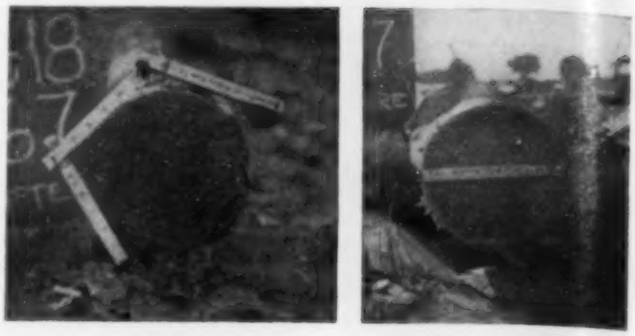


FIG. 6. PILE WITH LARGER TIP TOOK 125 HALF-IN. BLOWS WITH NEGLIGIBLE DAMAGE, SHOWING ADVANTAGE OF LARGER TIP

amounted to one-quarter of 1%. This is very cheap insurance for 60 years, the estimated life of the building.

The tests here described would seem to indicate conclusively that heavy driving is no solution to pile foundation problems. Especially is it necessary to avoid this practice in the case of timber piles that must pass through or come to rest upon, a solid stratum. When question marks arise, and underground is where most of them originate, it is necessary for the engineer to turn from purely technical to practical considerations and buy the extra insurance which longer and stronger piles will give. A bad roof can be fixed, but a bad foundation will "fix" the structure.

The architects for the Lafitte Avenue Housing Project were Rosenthal, Kessels and Jones, and Swanson, McGraw and Hooper were the civil engineers. Alvin M. Fromherz, M. Am. Soc. C.E., was consulting engineer and executive director for the Housing Authority of New Orleans, and the writer was resident engineer in charge at the site. John W. Mullen, who assisted in the preparation of this paper, was the assistant resident engineer.

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Cleaning a Large-Size Pipe Line in Place

By W. H. MEAD, M. AM. SOC. C.E.

CHIEF ENGINEER AND GENERAL SUPERINTENDENT, SALT FLAT WATER COMPANY, LULING, TEX.

DURING January 1930, the Salt Flat Water Company was formed by the oil producers of the Salt Flat Field at Luling, Caldwell County, Texas, to dispose of the salt water produced along with the oil. The impounding method was chosen. Appropriate pipe lines and pumping stations were built and a ten-million-barrel impounding reservoir constructed. Bell-and-spigot type cast-iron pipe was used with square hemp and leadite jointing material; single-stage centrifugal pumps were provided, with iron bodies and bronze impellers and shaft sleeves. The designed capacity of the system was 96,000 bbl per day.

The salt water from this field of Edwards limestone is high in carbonates and hydrogen sulfide gas. The calcium carbonate was deposited out on the inside of the pumps and pipe lines. This deposit protected the metal from the action of the hydrogen sulfide gas but finally so restricted the flow of the water that something had to be done. Temporary relief was had by acidizing the lines, but acid caused blowouts at the joints and was limited in its effectiveness. The largest acid treatment given at one time was 6,000 gal. The pumping requirements decreased to 50,000 bbl per day on account of abandoned wells and plug-back work, but finally the deposit in the pipe lines restricted their capacity to below this amount.

Accordingly, a contract for cleaning out the lines was made. The first step in the work was to determine the extent and thickness of the deposit by drilling and tapping the lines and installing 1-in. corporation cocks while the lines were in service. The deposit thickness was measured with a welding rod through these cocks.

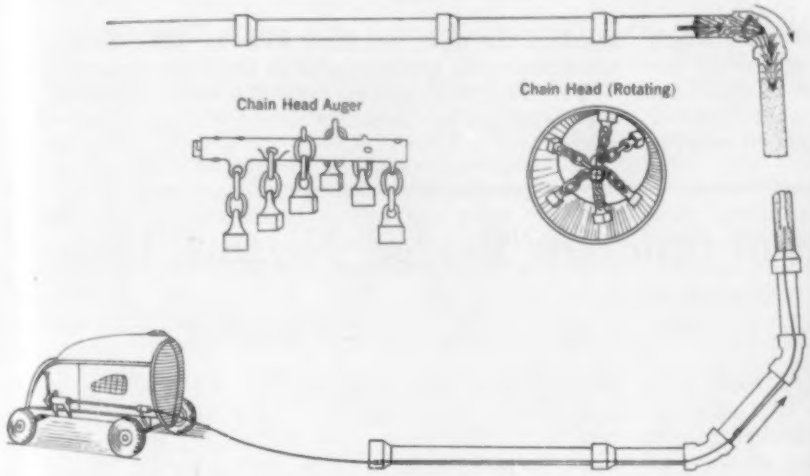


Fig. 1. Machine Chain Head Tool (Center) Is Centered in Pipe by Centrifugal Action of Rotating Rods

Access to the Pipe Was Gained by Removing 5-Ft Sections with an Electric Torch

Pressure gages were applied at the cocks to get a line on the pressure losses in the line due to friction. Readings were corrected for static head.

The preliminary work consisted of uncovering one joint of pipe in each section of the line, cutting out a 5-ft nipple, replacing it with a clean nipple, and closing the gaps with two bolted sleeves. These entrances were placed at the cross-drain ditches on the 10-in. and 12-in. lines, and at 800-ft intervals on the first mile of 20-in. pipe line out from our main pumping station.

Cutting of the pipe was done by electricity, using a 250-amp generator and $^{3}/_{16}$-in.-diameter rods on the positive pole. The two cuts were made and the nipple removed in $2^{1}/_{2}$ hours when the weather was clear. The accompanying photograph clearly shows the thickness of the deposit. The greatest restriction was at a point near the pump station, where the diameter remaining open for the passage of water was only 8 in. in a 20-in. pipe.

The principle of the cleaning machine is the milling away of the deposit by a tool in the end of a flexible rod rotated at about 800 rpm by a special machine. This machine is equipped with a whippet motor, chain connected to an outrigging shaft to which the flexible rods are attached. Advance into the line is made by pushing the whole machine ahead. One man does this. The rods are in 24-ft sections, and when the machine reaches the edge of the ditch, it is uncoupled from the rods in the pipe, backed up, and another section entered in the string. Two men perform the operation of connecting the rods. Figure 1 shows the machine and chain head tool. This tool is a round steel bar 18 in. long to which are attached 6 chains. (The length of the chains is determined by the diameter of the hole to be drilled.) On the end of each chain is a lug about the size of a 1-in. nut and covered with stellite or other hard metal. The tool is automatically centered by the centrifugal action of the twirling rod. The tool is run against a stream of water in the pipe line and as the lugs mill off the deposit, it is washed out to the entrance by the water, where it is shoveled out by hand. Our entrance ditch was kept clear of wash water and fine drillings by a 3-in. rotary, gasoline-motor-driven pump, capable of handling 20,000 gal per hr. The raising and lowering of the nipple was done with a chain hoist. A standard pipe cutter was used to mark out the circle for cutting the clean nipples and to make a straight groove for finishing with cold chisel and hammer. This saved much time.

In doing this work, the sleeves at the entrance were removed in the morning and the nipple raised up out of the hole. The water was pumped from the line and work started after about 30 minutes. At the end of the day's work, the nipple was put back and the line placed in service until work time the next morning.

On the 10-in. and 12-in. lines, there was no trouble whatever, and a length of 2,000 ft per day was cleaned. On the 20-in. line we drilled successively with 10, 12, 14, 16, and 20-in. tools. After getting to about the 16-in. size, we encountered caving in of the loosened layers of deposits in the pipe. If within reach, these slabs were pulled out by hand on a hook made of sucker rod. If out of reach, we milled them up with the tool and washed out the results.

The total cost of cleaning was, for the 10-in. pipe, 14.5 cents per ft; for the 12-in., 21.6 cents per ft; and for the 20-in., $1.06 cents per ft.

In this line there is a 1,600-ft loop of asbestos-cement pipe, of 12-in. inside diameter, which was installed to get line capacity past a section of the 20-in. line in which the deposit had built up until a passage only 8 in. in diameter remained. This was before we discovered the cleaning tool here described.

The asbestos-cement loop had been in use for four years and had a deposit of $1^{1}/_{2}$ in. distributed uniformly around the inside. To make the entrance for cleaning, we removed one joint, supported it on wooden horses, and cleaned it with the same tools used on the rest of the line. Thus we had a good opportunity to observe the action of the tool. The 12-in. tool was apparently so accurately centered by centrifugal force that the lugs seemed to barely scratch the pipe walls after the deposit was removed, and did no damage at all to the material of the pipe.

There were three corporation cocks in this pipe, which had been installed to check up on the deposit and to observe pressure losses. We found these cocks still firm in the pipe after cleaning. We backed them out to observe the effect of the tool on the ends which protruded into the inside of the pipe, but there was very little damage, and the same cocks were replaced in the same tapped holes.

The method described proved a very satisfactory one for cleaning out limestone deposits from a pipe line in place.

Weighing Reactions of Rainbow Bridge, Niagara Falls

By JONATHAN JONES, M. AM. SOC. C.E.

CHIEF ENGINEER, FABRICATED STEEL CONSTRUCTION, BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

THE new "Rainbow Bridge" at Niagara Falls is a 950-ft span, consisting of two hingeless ribs made up of box-plate girders, 12 ft deep. (Waddell and Hardesty and E. P. Lupfer Corporation were the engineers.) The erection scheme for this monumental structure required that the half ribs be cantilevered from the two sides of the gorge, that the two last sections in each rib, adjacent to the crown, be fabricated somewhat short, and that prior to the closure the crown thrust and moment should be regulated by weighing, and the "keystone" piece to complete each rib then milled to such measurements as would make the thrust and moment agree satisfactorily with those calculated for the loads then in place.

In other words, by weighing the crown thrust at a certain distance above the center line of the rib, and simultaneously at the same distance below the center line, this statically indeterminate structure could be rendered determinate, and corrections could be made in the closing piece for the errors, if any, in the survey of span length, in the skewback angle, and in the fabrication and erection of the ribs. Such a correction has not to the writer's knowledge been undertaken in the closing of hingeless arches previously constructed.

The total anticipated thrusts for each rib were on the order of 800 tons above, and 600 tons below, each rib. These forces would vary considerably with the temperature, and also as the top or bottom opening at the crown might be deliberately increased or decreased from the normal "keystone" space. Therefore elaborate calculations had to be made, and tables prepared in advance, expressing these variations for prompt use at the time of weighing.

The contractor, the Bethlehem Steel Company, felt an obligation to weigh these thrusts by the most accurate means that could be found, and used in the restricted spaces available. This company has hitherto obtained consistent results with hydraulic jacks equipped with Bourdon gages, but is aware that some engineers discount the accuracy of such equipment and have turned to the use of proving rings. In the present instance the large thrusts, the small space available, and the angular movements of the ribs, made proving rings impracticable.

Having failed to find any better equipment available, Bethlehem decided tentatively to carefully condition eight of its 500-ton hydraulic jacks, and to purchase for, and calibrate with them, new gages with finely subdivided 10-in. dials. An idea of the procedure may be gained from the accompanying sketches. Figure 1 (*a*) is an elevation showing the temporary jacking brackets bolted above and below the ribs. Figure 1 (*b*) is a section showing the eight jacks in position on the two ribs. Between the ribs is the space for shims to hold the loads when off the jacks. Each pair of jacks is shown equalized with a single pump and gage.

About the time the new gages were delivered, and after one of them had been calibrated in connection with another laboratory test, an offer was made to develop a pressure cell, or capsule, with a stationary diaphragm and no moving parts, thus eliminating the controversial issue of jack friction. The unit pressure on the fluid would be about 20,000 lb per sq in. for the 500-ton capacity of a jack, and thus would hold the capsule down to such a diameter that it could be placed in line with, and receive the load from, its jack. It was predicted that the behavior of these capsules would be without sensible error, and that such equipment would be limited in accuracy by nothing except the ability to truly calibrate the gages against actual pounds. Eight of these capsules, with gages, were accordingly purchased.

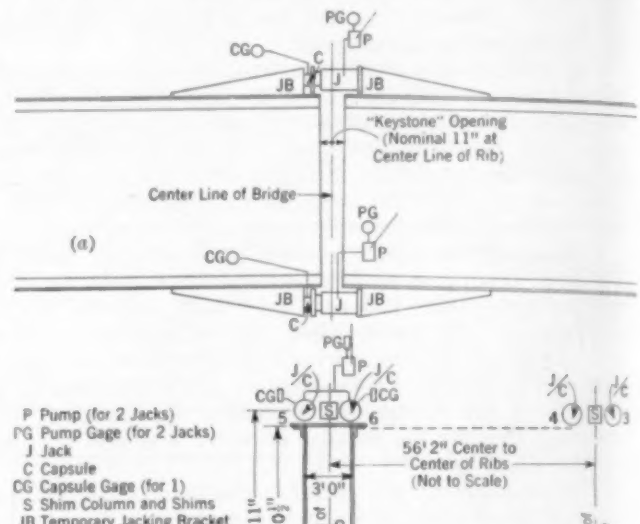


FIG. 1. ARRANGEMENT OF JACKS AND CAPSULES AT CENTER OF RAINBOW BRIDGE

(*a*) Elevation Showing Temporary Jacking Brackets Bolted Above and Below the Ribs, and (*b*) Section Showing Eight Jacks in Position on the Two Ribs

The chain of calibration steps did not appear to the contractor to be subject to any large errors. The 400-ton testing machine at the Fritz Laboratory, Lehigh University, had just been calibrated with proving rings calibrated at the Bureau of Standards. Each capsule was calibrated, with its gage, in the testing machine and all were carefully packed and shipped by express from Bethlehem to Niagara Falls. While this calibration did not reach to the full capacity of the 500-ton jacks, it did reach so nearly to the maximum expected load on

this particular job that almost no extrapolation was required.

In the calibration it was found that readings would repeat identically on ascending load, but poorly on descending load. It was accordingly decided to weigh, in the field, only on increase of thrust. Furthermore it was found that one of the eight did not repeat as identically, or on as straight a calibration line, as the other seven. Owing to the imminence of the field operation, it was not possible to hunt for and correct the cause of this trouble.

Because of the acquisition of this more refined equipment, the jacks were not recalibrated with their new gages. These jack gages were installed, however, and from Fig. 1 (*b*) it is seen that each of the two top and the two bottom thrusts could be read twice, once on a jack gage, and once on a pair of capsule gages.

The field work was done between midnight and 6 a.m. of May 26–27. The starting temperature was 64 F and this persisted until shortly before the final readings, when it had fallen to 60 F. All work was completed before daybreak, and well before the coming of sunrise could create differences of temperature over the steel work.

Thrust readings were taken at four different settings of the keystone open space. In each case the loads were slacked off well below the required amounts; the pumping was started; and when steel scales showed the predetermined openings at top and bottom, the loads were held constant, the measurements of openings checked, and all gages read.

The capsule that had been troublesome at the time of calibration was in Position 8 (Fig. 1 (*b*)). In all four measurements it showed erratic loads according to its calibration curve, as compared with the other three bottom capsules. Therefore for the fourth measurement, the south rib was first read, capsule No. 4 was transferred from it to the position of No. 8, and the north rib was read. This gave a consistent set of loads.

In Table I all the gage readings, reduced to tons, are given for the four sets of measurements; the jack gage readings are to be doubled, as one gage read a pair of identical jacks.

Parenthetically, it will be noted that while the total measured thrust was always very nearly equal to, but also always greater than, the computed thrust, the line of thrust as measured was always well above its computed position (the top measured loads being greater, the bottom measured loads less, than the computed ones). It is highly probable that this represents a small underestimate of the weights of the erection travelers and other erection equipment, which were near the crown at the time of measurement. If, for instance, enough additional temporary weights are assumed fairly near the crown, to account for the excess thrust as measured, they will also account for most of the upward displacement of the thrust line. The agreement between the computed and measured amount, and also position, of the crown thrust for the permanent steel is evidently closer than could have been anticipated in the building of a structure of such magnitude.

The point, however, to which it is desired to direct particular attention in these notes, is the correspondence between the thrusts read on the capsules and those read on the jacks, which was virtually identical in the final stage, after eliminating the suspected No. 8 capsule.

TABLE I. THE FOUR SETS OF GAGE READINGS, REDUCED TO TONS

Position	Gage	First Set	Second Set	Third Set	Fourth Set
North top	Capsule 5	423	429	402	426
	Capsule 6	424	434	407	432
	Jacks	425	422	407	430
North bottom	Capsule 8	308	282	320	277*
	Capsule 7	290	273	304	284
	Jacks	287	275	305	282
South top	Capsule 4	403	428	407	435
	Capsule 3	407	434	409	439
	Jacks	403	430	412	438
South bottom	Capsule 2	309	275	308	271
	Capsule 1	307	282	304	276
	Jacks	313	277	307	272
Total top	Capsules	1,657	1,725	1,625	1,732
	Jacks	1,656	1,704	1,638	1,736
	Computed	1,570	1,603	1,526	1,627
Total bottom	Capsules	1,214	1,112	1,236	1,108
	Jacks	1,200	1,104	1,224	1,108
	Computed	1,256	1,215	1,296	1,184
Total thrusts	Capsules	2,871	2,837	2,861	2,840
	Jacks	2,856	2,808	2,862	2,844
	Computed	2,826	2,818	2,822	2,811

* Capsule No. 4.

It is evident from this comparison, as shown in the final column of Table I, that the measurement of thrusts and reactions in large indeterminate structures can be carried out with well-conditioned hydraulic jacks and well-calibrated 10-in. dial gages, amply within the accuracy that may reasonably be desired—certainly with smaller errors than must necessarily occur in computing the dead loads and their theoretical reactions.

Slide Rule for Designing Reinforced Concrete Slabs

By W. N. Hazen, M. Am. Soc. C.E.
West Orange, N.J.

There are two advantages in designing reinforced concrete slabs by the use of a slide rule prepared especially for the purpose: (1) an economical design can be chosen, and (2) time and labor can be saved.

On the slide rule developed by the writer, and illustrated in Fig. 1, the slide carrying scales D and E has very little friction between it and the slide carrying scale F. Slides carrying scales B, C, D, and E move as a unit. The "factor for continuity" is the denominator of the bending moment equations (K denotes kips). Scales B and D are made longer than would usually be required. The extra heavy loads shown on scale B are convenient for designing rectangular beams and for finding the approximate breaking load. In order to read all scales at one setting, it is sometimes necessary to use a stress in steel, scale D, ten times greater than desired and multiply the amount of reinforcement, as read, by ten.

The method of using the slide rule for designing is as follows: First, set the maximum allowable unit stress in the steel opposite the appropriate "factor for continuity." Second, place the total load per square foot opposite the span. Third, select the depth of slab on scale E and read the amount of steel per foot width of slab on scale F. The depth of slab must be such as will not overstress the concrete; that is, the percentage of reinforcement given in Table I must not be exceeded.

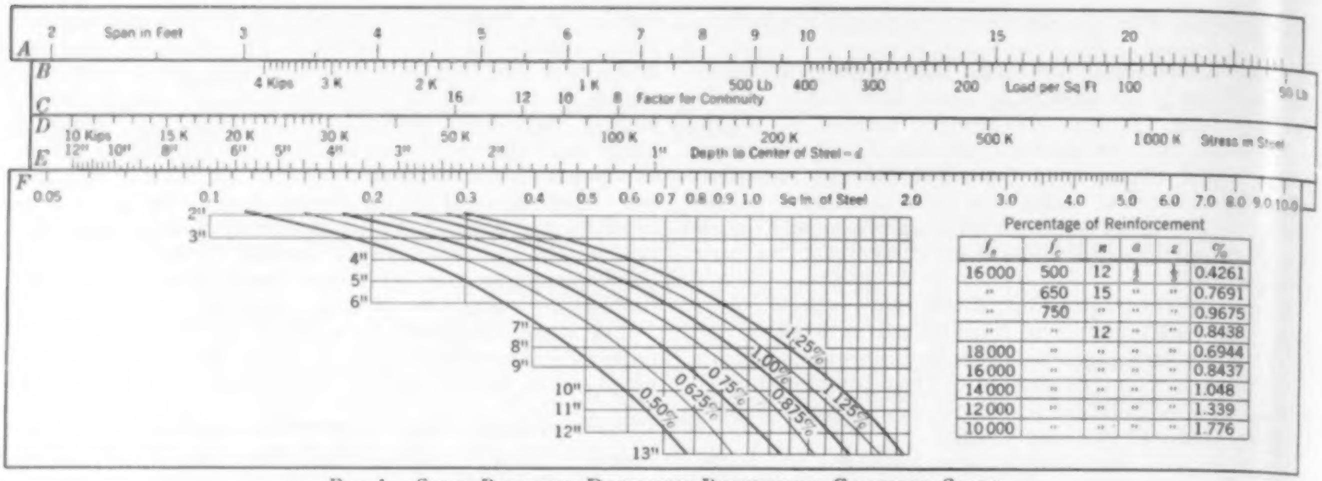


FIG. 1. SLIDE RULE FOR DESIGNING REINFORCED CONCRETE SLABS

The ordinates in the chart represent depth of slab to steel. From any assumed depth, scale E, drop a perpendicular to the ordinate in the chart of the same depth. If the intersection is below the percentage curve limit, such depth of slab can be used.

It is often desirable to make the thickness of slabs the same throughout a floor although the spans and conditions of continuity may differ. When conditions are not too varied, this can be accomplished, for longer spans, by reducing the stress and using a higher percentage of steel.

In order to limit the number of scales to six, the factor j has been assumed as 0.875. The table shows this assumed value to be on the side of safety for good concrete and the usual stresses. When the stress in the steel is reduced below that usually specified, more steel should be used, on account of the lower value of factor j.

TABLE I. PERCENTAGES OF REINFORCEMENT

f_s	f_c	n	j	p	f_s	f_c	n	j	p
10,000	750	12	0.8421	1.7763	16,000	600	15	0.8800	0.6750
12,000	750	12	0.8571	1.3393	16,000	650	15	0.8738	0.7691
14,000	750	12	0.8695	1.0481	16,000	700	15	0.8679	0.8667
16,000	600	12	0.8965	0.5819	18,000	600	12	0.9048	0.4762
16,000	650	12	0.8907	0.6657	18,000	650	12	0.8992	0.5458
16,000	700	12	0.8852	0.7531	18,000	700	12	0.8939	0.6123
16,000	750	12	0.8800	0.8438	18,000	750	12	0.8888	0.6944

The actual slide rule can be made of Bristol board and the divisions can be made much finer than in Fig. 1. The area of the steel can be read to two figures and estimated to a third.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Metric System Should Have Wider Study

TO THE EDITOR: May I ask whether or not an attempt has ever been made by the engineering profession to shift from our present system of units to the metric system? Have any definite studies in this direction ever been made?

It seems to me that our present system is crude and clumsy while the metric system is logical and readily usable. It is possible that a shift of unit systems could be brought about by a planned program of ten years' duration or longer. If, at regular intervals, a numerical example in, say, the "Engineers' Notebook" department of CIVIL ENGINEERING, were presented in the metric system civil engineers would have an opportunity to practice this system on problems in which they are particularly interested. This practice, over a period of years, would enable us to learn to think or write in terms of two unit systems. No previous generation has apparently dared to undertake this supposedly difficult task. I believe that some generation must do so eventually, perhaps as the beginning step in the development of an international language. All generations of physicists have been forced to learn to think in two unit systems of length and weight. Hence it should not be impossible for engineers to do the same.

Such a program as herein suggested would require the approval and support of a great majority of the profession, especially among the younger members. I would like to see expressions of opinion from Juniors in the Society. A generation of young men undertaking such a program would have to be more interested in its benefits to humanity than in financial returns as there would be little financial profit to their generation.

STANLEY U. BENSCOTER, Jun. Am. Soc. C.E.
Assistant Engineer,
U.S. Engineer Office

Vicksburg, Miss.

Computing Unsymmetrical Cable Spans

TO THE EDITOR: In the August issue C. M. Goodrich presented an interesting article on computing "Unsymmetrical Cable Spans." The formulas presented in this paper were derived from the parabola. In order to test the accuracy of these formulas a check was made, assuming that the cable conforms to a catenary. No discussion is included as to the relative merits of either method since the choice would vary with individual preference.

Let $\overline{Y}$ equal the mean ordinate for any portion of a catenary.

$$T = w\overline{Y} = 4{,}000 \text{ lb}, L_0 = 600 \text{ ft}, h = 15 \text{ ft}, \tan\alpha = \frac{15}{600},$$
$$H = wa \qquad (1)$$

From the properties of a free cable we can derive

$$\frac{\overline{Y}^2}{a^2} - \tan^2\alpha = \frac{2\cosh u - 2}{u^2} \qquad (2)$$

where $u = \frac{L_0}{a}$. On rearranging this equation, we have

$$u^2\left(\frac{\overline{Y}^2}{L_0^2} - \frac{1}{12}\right) = 1 + \tan^2 \alpha \quad \ldots\ldots\ldots\ldots (3)$$

in which higher powers of u have been discarded. Solving Eq. 3, $u = 0.1501877$ and $a = 3{,}995.00$ ft, a being the parameter of the catenary and governing its shape.

The sag at midspan,

$$S_0 = \frac{L_0\overline{Y}}{2a} \tan h \frac{L_0}{4a} = 11.27 \text{ ft} \quad \ldots\ldots\ldots\ldots (4)$$

agrees with Mr. Goodrich's $S_0 = 11.25$. The accuracy of Eq. 3 may be easily tested by including more terms of the series.

Thus

$$u_1^2\left(\frac{\overline{Y}^2}{L_0^2} - \frac{1}{12} - \frac{u^2}{360}\right) = 1 + \tan^2 \alpha \text{ and } u_1 = 0.1501878 \ldots (5)$$

The useful limits of Eq. 3 have not been determined. However, it may be extended to any degree of refinement desired, by adding more terms in the bracket.

The catenary relations will be found particularly useful when dealing with the arc lengths of free cables. Thus we can write.

$$l_0 = \frac{\overline{Y}L_0}{a} = 600.751 \text{ ft} \quad \ldots\ldots\ldots\ldots (6)$$

in which l_0 is the catenary arc length for span L_0 under the given conditions of the problem. Then

$$l = \sqrt{l_0^2 - h^2} = 600.564 \text{ ft} \quad \ldots\ldots\ldots\ldots (7)$$

This is the arc length of a symmetrical catenary about the $Y - Y$ axis having the span L_0 and parameter a.

The work may be short cut within limits by $l = L_0 + \frac{w^2L_0^3}{24H^2} = 600.564$ which agrees with Eq. 7. Also Eq. 4 may be approximated by $S_0 = \frac{u^2\overline{Y}}{8} = 11.28$ ft.

ALLEN H. BROWNFIELD, Assoc. M. Am. Soc. C.E.
Sacramento, Calif.

Engineers and Engineering in Ancient Times

DEAR SIR: In an excellent article on "Specifications and Plans of Ancient Times," in the July issue, Prof. Richard S. Kirby pointed out a regrettable omission of the names of designers of notable structures of ancient times. As a matter of fact, far from being suppressed in the official records of Egypt, at least, the names of the eminent engineers and architects of that kingdom have been commemorated to a far greater extent than those of other civil servants.

Beginning with Imhotep, chief architect and builder of the step-pyramid of Sahkara (circa 3000 B.C.) during the reign of Zoser of the Third Dynasty of the Old Kingdom, twenty-four royal architects have been listed by Brugsch Bey. Of outstanding ability were Ineni, in charge of all the works at Karnak; Senmut, chief constructor, with his brother Senmen, of the famous temple near Del-el-Bahri; Puamra, obelisk engineer; Amenhotep, successor to Puamra and famed as obelisk designer and hydraulic engineer; and others in a list that extends chronologically to the Middle Kingdom.

Let me add a word in defense of Ineni. Too much emphasis, it seems, has been placed on a few unfortunate boastful remarks uttered in the afterglow of a sumptuous royal banquet and misquoted, no doubt, in a local tabloid. Rather let him be remembered for his outstanding creative genius and versatility. "With utmost secrecy," he states in his memoirs (circa 1500 B.C.), "followed experiments with materials and plasters, always on the lookout for the best materials; clay fields were made in order to plaster tombs and these experiments I made for the benefit of those to follow."

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Boston, Mass.

Reservoirs for Flood Control

TO THE EDITOR: In connection with the writer's article on "Multiple-Purpose Reservoir Operation," which appeared in the May and June issues of CIVIL ENGINEERING, attention has recently been called to the fact that the Lake of the Woods Reservoir, located near the boundary between Minnesota and Canada, was perhaps one of the first large multiple-purpose reservoirs to be planned and, after some delay, constructed. In support of this, reference was made to a discussion by Adolph F. Meyer, M. Am. Soc. C.E., on "Reservoirs for Flood Control" (published in the TRANSACTIONS of the Society for 1918, pages 1498 to 1501), which I have since read with much interest.

A diagram (Fig. 8) in this discussion shows the manner in which the available storage space in the Lake of the Woods Reservoir "was subdivided in order to secure the greatest aggregate advantage to all interests." In other words, Mr. Meyer indicated the allocation of storage space to the several uses.

Inasmuch as the development of large multiple-purpose reservoirs has come largely during the last ten or fifteen years or even less, the writer is glad to call attention to Mr. Meyer's work along this line of about a quarter of a century ago.

NICHOLLS W. BOWDEN, M. Am. Soc. C.E.
Principal Hydraulic Engineer,
Tennessee Valley Authority
Knoxville, Tenn.

Need for Microfilm Technique in Reproducing Technical Articles

TO THE EDITOR: The letter by Stanley U. Benscoter regarding the use of microfilm technique in the reproduction of technical articles, which appears on page 672 of CIVIL ENGINEERING for November, strikes a sympathetic chord in my personal experience. I feel that, in this letter, Mr. Benscoter has made a point which could well be followed up by the publications of the Society and other technical journals of interest to engineers.

Being engaged in research work pertaining to the engineering phases of agricultural hydrology, I find it desirable and necessary to read a large number of technical publications and, in many cases, to keep the articles or briefs of the articles for quick personal reference. To build up such a large personal library and transport it from one location to another, I find practically beyond my resources; and I imagine most technical workers are confronted with the same problem. However, if the desired articles were available on microfilm, the cost of building up such a library and transporting it would be reduced to a nominal cost well within the reach of most individuals. I strongly urge that full consideration and support be given the suggestion made by Mr. Benscoter.

H. S. RIESBOL, Assoc. M. Am. Soc. C.E.
Moscow, Idaho

The Literature of Soil Mechanics

TO THE EDITOR: It was almost inevitable that such a paper as "The Study of Earths—an American Tradition," in the August issue of CIVIL ENGINEERING, would be written. It is well that it has been written by a young man. The author should be congratulated on his discrimination in restricting the evidence to American literature, for his clear presentation of that evidence, and for resisting the obvious temptation to elaborate deductions.

To me the important thing here is not that these things have been said before, but that they have been said in America. It is not a matter of antiquarian interest but of practical importance. Here is the background, and here the language of that great number of practical builders who have constructed and continue to construct our foundations. In general they are not a garrulous lot, but what they have to say is very important. Anyone who knows the breed knows that they will choose to use the simple language of field men. To ask them to abandon that language is worse than impertinent; it is unwise.

I hope that Mr. Baron will publish more of the material that he has collected.

HARDY CROSS, M. Am. Soc. C.E.
Professor of Civil Engineering
Yale University
New Haven, Conn.

SOCIETY AFFAIRS

Official and Semi-Official

Plans for Eighty-Ninth Annual Meeting

A Varied Program of Technical and Social Events Scheduled for January 21–24, in New York City

A PROGRAM pitched both at current defense construction and at immediate planning for construction in the post-war period, and replete with both technical and social interest, is in the making for the Eighty-Ninth Annual Meeting of the Society to be held in New York. The meeting begins on Wednesday, January 21, 1942, and continues through the rest of the week. The Engineering Societies Building will be the place for the general business meeting, the members' luncheon on Wednesday, and the technical sessions which will follow on Wednesday afternoon and all day Thursday.

The nearby Biltmore Hotel is designated as the Convention Hotel Headquarters. The dinner-dance will be held in the magnificent Grand Ball Room of the Waldorf-Astoria Hotel on Wednesday evening, January 21, 1942. The Smoker has been scheduled for Thursday evening, January 22, 1942, at 8:00 o'clock, at Manhattan Center, with a program of light refreshments and entertainment, similar to that of last year.

On Thursday afternoon the ladies are to be entertained with a fashion show and tea at the Biltmore Hotel.

The Metropolitan Conference of Student Chapters has planned an interesting program for a Student Chapter Conference on Wednesday afternoon, in the Engineering Societies Building. All Student Chapters are invited to send delegates.

For members, the Meeting opens with a general business meeting on Wednesday morning. This will include a report on the Society's activities for the year; the solemn and impressive ceremony of awarding Society prizes and conferring Honorary Membership; and the induction of the newly elected officers into their respective offices.

It is expected that the recipients of the Norman Medal, the J. James R. Croes Medal, the Thomas Fitch Rowland Prize, the James Laurie Prize, the Arthur M. Wellington Prize, the Collingwood Prize for Juniors, the Construction Engineering Prize, the Karl Hilgard Hydraulic Prize, the Rudolph Hering Medal, and the Daniel W. Mead Prize to a Junior and Student Chapter member of the Society, will be present to receive their awards in person. The prize winners have already been selected and their names, together with the papers for which the prizes were awarded, appeared in the November issue of CIVIL ENGINEERING. An impressive group of prizes, consisting of checks, gold medals, and certificates, will be presented at the ceremony.

Honorary Membership in the Society is to be conferred on five distinguished civil engineers who are all members of the Society. Those elected for this honor are Ralph Budd of Chicago, Ill., William Kelly of Buffalo, N.Y., Henry E. Riggs of Ann Arbor, Mich., J. L. Savage of Denver, Colo., and Henry M. Waite of Washington, D.C.

At the business session, the tellers will report on the canvass of the ballot for the newly elected officers, and a proposed amendment to the Constitution will be discussed. After the formalities of inducting the new President into office and introducing the new members of the Board of Direction to the membership, the meeting will recess for a luncheon to be served in the Engineering Societies Building. You will meet your friends and renew old acquaintances at this luncheon.

TECHNICAL PROGRAM

On Wednesday afternoon the Meeting will break up into separate Technical Division sessions. A condensed schedule follows:

Wednesday Afternoon

Sessions of Technical Divisions:

Construction—"Construction of National Defense Projects"
Sanitary Engineering—Reports of Division Committees
Waterways—Papers on "East River Improvement, New York" and on "Beach Protection"

The Society's Committee on Preparedness for Post-War Conditions is sponsoring an open session to discuss the preparation of engineering plans now for worthwhile public works to be built after the present emergency is over.

Thursday Morning and Afternoon

Sessions of Technical Divisions:

City Planning—"The Effect of Defense Project Locations on Official City Plans"
Engineering Economics—"Cost Allocation for Multiple-Purpose Water Projects"
Highway—"Influence of Parkways on Highway Traffic" and "One Year's Operation of the Pennsylvania Turnpike"
Hydraulics—Symposium on "Hydrology in Relation to Floods"
Sanitary Engineering (2 sessions)—Papers on "Rapid Sand Filters," "Sludge Handling," "Illinois Waterway Litigation," "The Delaware River Water Supply," and "Sanitation Facilities for Military Posts"
Soil Mechanics and Foundations (all day)—Symposium on "The Present Status of the Art of Obtaining Samples, Particularly Undisturbed Samples, for Soil Testing"
Structural—Papers on "Civilian Bomb-Proof Construction with Observations from Britain"
Surveying and Mapping—An open meeting of the Division's Executive Committee

EXCURSION—INSPECTION TRIPS—REUNION DINNERS

Friday morning is being reserved for the showing of an interesting and dramatic group of motion pictures on current construction works in the United States. The Excursion Committee has arranged for a boat inspection to points of engineering interest in New York Harbor with a box luncheon served on board the boat. The boat will leave at 11:30 a.m., immediately following the close of the Friday morning session.

AIR VIEW OF EASTERN END OF BERMUDA
Site of New Army Air Base to Be Visited on Route of Society Tour

Ten or more groups of engineering college alumni have planned for reunions at the time of the Meeting of the Society. Many of them will be dinner meetings on the night of, and prior to, the start of the Smoker.

On Saturday morning, the Sanitary Engineering Division, in co-operation with the New York State Sewage Works Association, will have an inspection trip to sanitary works in the vicinity of Manhattan Island. A number of other short inspection trips to nearby engineering works have been arranged for Saturday morning.

At 1:00 o'clock on Saturday, the S.S. *Acadia* will sail for Bermuda. Arrangements are being made to accommodate interested members of the Society and their ladies on this ship. As a special courtesy, Army and Navy officials have indicated a willingness to permit members of the Society to inspect the construction work at the naval and military bases on the island of Bermuda. For reservations and other matters pertaining to this inspection trip, inquiries should be directed to the Secretary.

Make Reservations Early

A summary of the program of the Meeting and a registration card will be mailed to the membership to enable members to order tickets for trips and social events in advance. This fine program for the Annual Meeting has been geared to current engineering interest and events. The meeting offers an opportunity to combine business, professional advancement, and personal pleasure in a trip to New York in January.

Final details of the program will appear in the January issue of Civil Engineering. Make plans now to attend the Eighty-Ninth Annual Meeting of the Society.

Professional Records of Nominees

Brief Biographical Sketches of Candidates for Society Offices

Ernest B. Black

Ernest B. Black was born in Mt. Sterling, Ill., in 1882, and educated at the University of Kansas, receiving the B.S. degree in 1906. Later (1924) he was granted the degree of C.E. From 1905 to 1906 he was assistant masonry inspector for the Santa Fe Railroad, and from 1906 to 1909 assistant engineer for the Riggs and Sherman Company, engaged on the design and construction of water, sewer, and paving projects in Indiana, Ohio, and Michigan.

Since 1909 Mr. Black has been in private practice in Kansas City, Mo.—first with the J. S. Worley Company and later with the successor firms of Worley and Black and (since 1915) Black and Veatch. These firms have specialized in water supply, water and sewerage treatment, power projects, and valuations, and have served on numerous projects throughout the West and the Southwest. From 1916 to 1919 he was also a partner in the firm, Thompson and Black, of New York, Detroit, and Kansas City, concerned with engineering features of the financial investigations of that firm.

Ernest B. Black
Nominee for President of the Society

During the World War Mr. Black served, first, as construction engineer on the construction of Camp Pike, Arkansas. Later (December 1917) he was commissioned a captain in the Signal Corps, serving first as chief engineer for the War Credits Board and, then, as engineer for Section B of the Construction Division. He was discharged in December 1918 with the rank of major, Air Service, Aircraft Production. In the present emergency his services include the design and construction of the Armored Division Camp, Camp Chaffee, near Fort Smith, Arkansas.

Elected an Associate Member of the Society in 1910 and Member in 1917, Mr. Black served as Director from 1932 to 1934. He has been a member and chairman of the Society's Committee on Local Sections and of the new Executive Committee of the Engineering Economics Division; a member of the Committee on Membership Qualifications, the Committee on Professional Activities, the Joint Committee on Depreciation, and the Committee on Preparedness for Post War Conditions; and is now a member of the Committee on Technical Procedure. He also served on the 1932 Annual Convention Committee and the 1933 Fall Meeting Committee. Long active in the affairs of the Kansas City Section, Mr. Black was president in 1928, and has been on the Local Membership Committee of the Section continuously since 1925.

His other professional affiliations include the American Institute of Consulting Engineers, the New England Water Works Association, the American Water Works Association, and the Engineers' Club of Kansas City, of which he is a former president. He has just completed a year as president of the Missouri Society of Professional Engineers, which was active in securing the law requiring the registration of Missouri engineers. He is completing his second year as president of the Kansas City Area, Boy Scouts of America, while numerous other civic and community activities also claim a great deal of his time.

Charles Milton Spofford

Charles Milton Spofford was born at Georgetown, Mass., on September 28, 1871. He received his S.B. degree from Massachusetts Institute of Technology in 1893, and was a postgraduate student in civil engineering in 1893 and 1894. In 1895 and 1896 and during the summer of 1897, 1898, and 1899, he was a draftsman for the Phoenix Bridge Company at Phoenixville, Pa.

From 1896 to 1905 he was at the Massachusetts Institute of Technology, successively as assistant, instructor, and assistant professor of civil engineering. From 1905 to 1909 he was professor of civil engineering at the Polytechnic Institute of Brooklyn (N.Y.), returning to his alma mater in the latter year as Hayward Professor of Civil Engineering, in which position he remained until 1940. He was head of the department during most of this period and chairman of the faculty for two years. Since 1940 he has been Hayward Professor of Civil Engineering Emeritus, and he has been a member of the consulting firm of Fay, Spofford and Thorndike, of Boston, Mass., since its organization in 1914.

Professor Spofford has been identified with numerous important engineering projects. He has served as expert engineer on the investigation of strength of Blackwell's Island Bridge; as a member of the Boston Terminal Commission, and of the Advisory Committee on Charles River Bridges for the Metropolitan District Commission of Massachusetts; as advisory engineer for the Boston Branch of the Reconstruction Finance Corporation; and as consulting bridge engineer for the Tennessee Valley Authority (1934 to 1935).

Charles M. Spofford
Nominee for Vice-President, Zone I

The engineering practice of his firm has included the Boston Army Supply Base (a $25,000,000 war project); the Lake Champlain Bridge and Rouses Point Bridge between the states of New York and Vermont; the Sagamore Bridge and the Bourne High Level Bridge, across Cape Cod Canal, at Bourne, Mass. (the latter

receiving the award of the American Institute of Steel Construction for the most beautiful steel bridge in its class built in the United States in 1934); port developments in the United States and New Zealand; and the design of shipways for the Bethlehem Shipbuilding Corporation at Fore River, Mass. At present his firm is the engineering member of Architect-Engineers for Newfoundland Army Bases, and a member of Dry Dock Engineers engaged in designing eight dry docks and numerous other structures for the U.S. Navy.

Professor Spofford joined the Society as an Associate Member in 1902, becoming a Member in 1905. He served as Director from 1925 to 1927 and received the second Phebe Hobson Fowler Award in 1930. He has been chairman of the Waterways Division and of the Alfred Noble Prize Committee, and at present is chairman of the Society's Committee on the Tacoma Bridge Failure. Since 1940 he has also been a member of the Herbert Hoover Medal Award Committee.

His other technical affiliations include membership in the Institution of Civil Engineers, the International Association for Bridge and Structural Engineering, the American Society for Testing Materials, the American Railway Engineering Association, and the Boston Society of Civil Engineers, of which he is a past president. He is author of *Notes Upon the Theory of Structures* (1907), *The Theory of Structures* (1911), and *Theory of Continuous Structures and Arches* (1937).

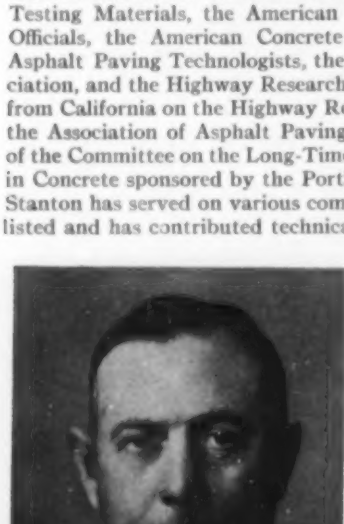
Thomas E. Stanton

Thomas E. Stanton was born in Los Angeles, Calif., on May 31, 1881, and graduated from the University of California in 1904 with the degree of B.S.

His professional career has consisted of 7 years with the City Engineering Department of Los Angeles and 29 years with the California State Division of Highways—the past 13 years as chief of the Materials and Research Department.

He was elected an Associate Member of the Society in 1919, a Member in 1920, and a Charter Member of the Sacramento Section in 1921. He served as president of the Sacramento Section in 1930 and ex-officio chairman of the Spring Meeting of the Society held there that year. In 1934 he was appointed by President Eddy to the newly formed Aims and Activities Committee, out of which grew the present Committee on Professional Objectives. He served as a Director of the Society from 1937 to 1939 and is a member of the Committee on Salaries.

In addition to his Society and Local Section affiliations, Mr. Stanton is a member of a number of other national technical associations and societies. These include the American Society for Testing Materials, the American Association of State Highway Officials, the American Concrete Institute, the Association of Asphalt Paving Technologists, the American Road Builders Association, and the Highway Research Board. He is contact member from California on the Highway Research Board, vice-president of the Association of Asphalt Paving Technologists, and a member of the Committee on the Long-Time Study of Cement Performance in Concrete sponsored by the Portland Cement Association. Mr. Stanton has served on various committees of all the organizations listed and has contributed technical papers to the Proceedings of these societies and to the technical press. One of his papers—published in the 1938 *Proceedings* of the American Concrete Institute—was awarded the Wasson medal for noteworthy research reported that year. In addition to his technical interests, Mr. Stanton has been active in civic affairs. He had an active part in the establishment of a retirement system for state employees and is president of the Board of Administration of the State Employees Retirement System. He was one of the founders and the first state president of the California State Employees Association and served as chairman of the committee which drafted and successfully campaigned for a state constitutional amendment relating to Civil Service in 1934.



Thomas E. Stanton
Nominee for Vice-President, Zone IV

Van Tuyl Boughton

Van Tuyl Boughton was born in Troy, N.Y., on September 9, 1888, and graduated from Lafayette College with the degree of civil engineer in 1911. The summer and early fall of 1910 were spent as a rodman on the Canadian Pacific Railway and, upon graduation the following June, he returned to the Canadian Pacific to become an instrumentman in the division office at Sudbury, Ontario. In November 1912 he was appointed division engineer at Chapleau, Ontario, where he remained until 1916 when he returned to Sudbury to become division engineer.

Van Tuyl Boughton
Nominee for Director, District 1

When the United States declared war in April 1917, Mr. Boughton resigned and came to New York to enlist in the 11th Engineers (Railway), U.S. Army, becoming successively supply sergeant, master engineer, first lieutenant, and captain, returning from France in the spring of 1919 as adjutant of the regiment.

Upon his discharge from military service Mr. Boughton went back to the Canadian Pacific Railway to become assistant superintendent (and temporarily acting superintendent) of the Chapleau Division. This position he resigned in January 1921 to return to New York to get back into engineering work. There he joined the engineering staff of the New York Water Power Investigation, then engaged in making studies for further expansion of the state's water-power resources. From that work he went to the Sherman Island Dam above Glens Falls, N.Y., as a masonry inspector for the Parklap Construction Company, later becoming an extra gang foreman.

In March 1923 Mr. Boughton joined the editorial staff of *Engineering News-Record* as an assistant editor, specializing in railroad and hydroelectric subjects. He was appointed managing editor in 1928 and associate editor in 1941.

He joined the American Society of Civil Engineers in 1923, served as a member of the Society's Committee on Public Education from 1934 to 1938, and as chairman of its Special Committee on Unionization in 1937 and 1938. He has also served the Metropolitan Section as secretary, director, vice-president, and president.

His other affiliations include membership in the American Railway Engineering Association, the New York State Society of Professional Engineers, and the National Society of Professional Engineers. He is vice-chairman of the board of the Plainfield Public Library and author of the *History of the 11th Engineers.*

George W. Burpee

George W. Burpee was born in Sheffield, New Brunswick, Canada, on November 9, 1883. He became a resident of the United States at the age of eight, and subsequently a citizen by naturalization. He graduated from Bowdoin College in 1904 with the degree of A.B. and from the Massachusetts Institute of Technology in 1906 with the degree of S.B. (civil engineer). In 1939 Bowdoin granted him the honorary degree of Sc. D.

Upon graduation from Massachusetts Institute of Technology, he entered the employ of the Louisville and Nashville Railroad as a draftsman in the office of the chief engineer at Louisville, Ky. In 1907 he became connected with Westinghouse, Church, Kerr and Company, of New York—first, as field engineer and later as assistant superintendent on various projects until 1911 when, for a period of seven months, he was resident engineer for the Canadian Northern Ontario Railway on a section of its Toronto-Ottawa line.

In 1912 Mr. Burpee resumed his employment with Westinghouse, Church, Kerr and Company, serving as engineer in charge of various railroad and industrial projects. From 1917 to 1919, he was the resident representative of his company on the construction of U.S. Nitrate Plant No. 2 at Muscle Shoals, Ala. In the

George W. Burpee
Nominee for Director, District 1

latter year he was made managing engineer, and when Westinghouse, Church, Kerr and Company merged with Dwight P. Robinson in 1920, he continued in the same capacity with the latter company.

In August 1921 Mr. Burpee became associated with the consulting firm of Coverdale and Colpitts, was made a partner in 1924, and has since continued in that connection. His firm has been active in the field of engineering investigations especially in connection with financial and management problems and transportation agencies. Among the continuing activities carried on by Mr. Burpee as a partner in his firm were engineer for the Manhattan Railway, New York, from 1921 until the sale of the railway property to the city in 1940, and consulting engineer to the Gulf States Steel Company (Birmingham, Ala.) from 1927 to 1937. He has served many corporations and government bodies as an expert on valuation matters, and as an adviser as to prospective earnings of toll facilities.

He was elected a Junior in the Society in 1907, Associate Member in 1911, and a Member in 1917. At present he is one of the Society's representatives on the Engineers' Council for Professional Development. Mr. Burpee has also been active in the Metropolitan Section, which he has served as president.

He is a member of the American Institute of Consulting Engineers (of which he is a former president), of the New York State Society of Professional Engineers, of the Engineering Institute of Canada, and an associate of the American Railway Engineering Association. He is also a member of Phi Beta Kappa. Mr. Burpee has also been active in civic affairs in the village of Bronxville, N.Y., where he resides, having served in various public service capacities.

Scott B. Lilly

Scott B. Lilly was born in Poweshiek County, Iowa, on May 27, 1885. He was graduated from Michigan State College with a B.S. degree in 1907, and from Cornell University with a C.E. degree in 1909. He took advanced work in the graduate school of Cornell in 1909 and 1910.

He was an instructor at Cornell from 1907 to 1910, going in the latter year to Swarthmore College as assistant professor of civil engineering. He remained at Swarthmore until the entry of the United States into the World War, during which he was with the Merchant Shipbuilding Corporation in the capacity of assistant plant engineer. He then, for a time, maintained a consulting practice in Philadelphia. From 1919 to 1921 Professor Lilly was with J. N. Kinney, contracting engineer, in New York City; from 1922 to 1923 with the Ohio Locomotive Crane Company; from 1924 to 1926 with the Florida Rock Products Company, Tampa, Fla., as resident engineer in charge of construction; and from 1926 to 1928 with P. T. King as sales engineer. In 1929 he returned to Swarthmore College as professor of civil engineering, and since 1936 has acted as chairman of the Division of Engineering at that college.

Scott B. Lilly
Nominee for Director, District 4

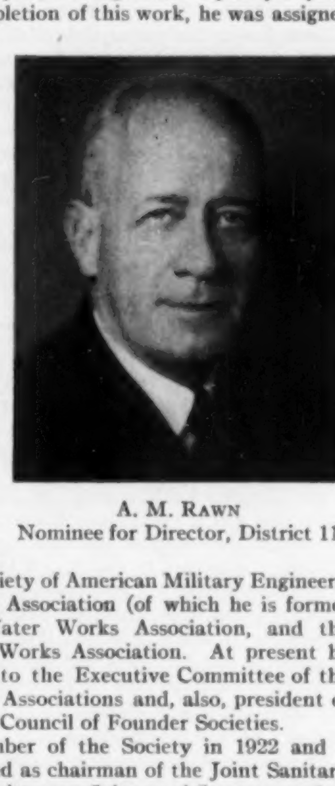
He is co-author of *Analytical Mechanics* (Miller and Lilly, 1914, revised 1935) and of "Effective Moment of Inertia of a Plate Girder" (Lilly and Carpenter, Transactions of the Society, Vol. 105, page 1462) and author of other articles.

Professor Lilly became a Member of the Society in 1931. For several years he has been active in the Philadelphia Section, acting as chairman of the Student Chapter Committee from 1932 to 1939; director from 1934 to 1936; vice-president from 1937 to 1939; and president in 1939 and 1940. He was a member of the Society's Administrative Committee on Juniors from 1938 to 1940, and served as chairman in the latter year. He is a member of the American Concrete Institute, the Society for the Promotion of Engineering Education, Sigma Xi, Tau Beta Pi, and Sigma Tau.

A. M. Rawn

A. M. Rawn was born in Dayton, Ohio, on November 2, 1888, and educated in the public schools of Toledo, Ohio. From 1905 to 1909 he was employed by the Illinois Central Railway Company in subprofessional engineering positions dealing with railroad construction and maintenance in Illinois, Tennessee, and Louisiana. In 1910 he moved to the State of Washington and found employment in the engineering department of the U.S. Reclamation Service (now the U.S. Bureau of Reclamation) on the Yakima Irrigation Project, serving in subprofessional and professional capacities there and on the Boise Project, Idaho; the Salt River Project, Arizona; and the King Hill Project, Idaho, until the outbreak of the World War. During the war he served as an enlisted man in the 319th Engineers, a California Regiment, and as a first lieutenant in the 605th Engineers, A.E.F.

At the close of the war Mr. Rawn returned to complete the construction of the King Hill Project, serving in the capacity of project manager. Following completion of this work, he was assigned to the study of the Columbia Basin Project in Washington, with headquarters in Spokane. After preparing the designs and estimates for the proposed distribution system for both the gravity and pump projects, he resigned from the Service and moved to Los Angeles, Calif. There he accepted the position of assistant chief engineer of the Los Angeles County Sanitation Districts, and he has served in the latter capacity and as chief engineer and general manager of the Los Angeles County Sanitation Districts since 1924. Mr. Rawn is, also, an associate editor of *Water Works and Sewerage* and of *Western City.*



A. M. Rawn
Nominee for Director, District 11

His professional affiliations include membership in the Society of American Military Engineers, the California Sewage Works Association (of which he is former president), the American Water Works Association, and the Arizona Sewage and Water Works Association. At present he is Western delegate-at-large to the Executive Committee of the Federation of Sewage Works Associations and, also, president of the Los Angeles Engineering Council of Founder Societies.

Elected an Associate Member of the Society in 1922 and a Member in 1924, he has served as chairman of the Joint Sanitary and Irrigation Division Committee on Salvage of Sewage; and as member of the Executive Committee of the Sanitary Engineering Division, and of the Professional Objectives Committee. He was president of the Los Angeles Section in 1938.

William D. Dickinson

William D. Dickinson was born in Arkansas City, Ark., on November 20, 1881. His education consisted of four years spent in the engineering school of the University of Arkansas, followed by two years in Arkansas Law School, from which he received the degree of LL.B. He is a licensed attorney.

His early engineering experience was obtained as levelman, traversman, and topographer for the U.S. Geological Survey. In the latter part of 1905 he entered railroad work as an instrumentman on construction of the St. Louis, Memphis and Southeastern branch of the Frisco Railroad. After a period of about one year,

WILLIAM D. DICKINSON
Nominee for Director, District 14

he was employed by the Missouri North Arkansas Railroad, on which for a period of three years he was, successively, topographer, locating engineer, resident engineer on construction, and bridge engineer. In 1909 he helped organize the engineering firm of Dickinson and Watkins, of Little Rock, Ark. In 1926, upon the withdrawal of Mr. Watkins, the firm was incorporated as Dickinson and White, Engineers, Inc., engaged in the design, supervision, and construction of general engineering work, appraisals, rate making, and consulting. The firm is acting as consultants for the City of Little Rock in the construction of its municipal airport. Some of Mr. Dickinson's personal assignments have been constructing a sanitary sewer system at Camp Pike, water works and sanitary sewer systems at the picric acid plant in the vicinity of Little Rock during the World War; hydroelectric studies for development of Little Red River; engineer in charge of roads and streets, at Camps Joe T. Robinson and Chaffee, in Arkansas.

For the past 28 years he has been chief engineer of the Plum Bayou Levee District in Pulaski, Lonoke, and Jefferson counties, Arkansas. During this period the system of flood protection work has been extended from 40 miles to a present length of approximately 100 miles.

In 1910 Mr. Dickinson became an Associate Member of the Society, and in 1917 a Member. He was active in the organization of the Mid-South Section, which he has served as vice-president and director. He is a member and former president of the Arkansas Engineers Club and the Little Rock Engineers Club, and a member of the National Society of Professional Engineers. Mr. Dickinson was active in the preparation and passage of the registration law in Arkansas and is a registered civil engineer in that state.

JOHN T. L. MCNEW

JOHN T. L. MCNEW was born at Belcherville, Tex., on January 20, 1895. He is a graduate in civil engineering from the Agricultural and Mechanical College of Texas where he received the bachelor of science degree in 1920, and the master of science degree in 1926. In 1925 he was awarded the degree of civil engineer by Iowa State College.

During 1918 and 1919 Professor McNew was with the 113th Engineers in France as a 2d Lieutenant of Engineers, and at the conclusion of the war returned to Texas to complete his college work. Immediately thereafter he joined the staff of the civil engineering department at his alma mater, the Agricultural and Mechanical College of Texas. In 1925 he became professor of highway engineering, and in 1940 was appointed head of the department of civil engineering. Since 1920 his time outside of school duties has been devoted to engineering practice, primarily in the field of highway engineering, and this work has taken him to all parts of Texas.

JOHN T. L. MCNEW
Nominee for Director, District 15

He was elected Associate Member of the Society in 1924 and a Member in 1929. His service in the Society started with his election as secretary-treasurer of the Texas Section in the fall of 1927, a position which he held for ten years. In 1938 he became president of the Texas Section, and in 1939 and 1940 served as a member of the Board of Directors of the Section. In addition to editing *The Texas Engineer*, the official publication of the Section, he has contributed discussions to the Society's publications, and has served as a member of the Society's Committees on Juniors and Local Sections. He is also a member of the Society for the Promotion of Engineering Education.

Meeting of the Board of Direction—Secretary's Abstract, October 13-14, 1941

ON MONDAY and Tuesday, October 13 and 14, 1941, the Board of Direction met at the Palmer House in Chicago, Ill., with President Frederick H. Fowler in the chair, and Secretary Seabury and the following members of the Board in attendance: Past-Presidents Riggs and Hogan; Vice-Presidents Jacobs, Lucas, and Burdick; and Directors Blair, Bres, Brooks, Carey, Cunningham, Dunnells, Goodrich, Howard, Hudson, Hyde, Leeds, Lewis, Massey, Polk, Requardt, Sawin, Wiley, and Treasurer Trout.

Regrets were received from Vice-President Stevens and from Directors Cowper and White.

Executive Committee Business

A number of matters were transmitted to the Board for disposition from the Executive Committee, which had met the preceding day (Sunday), and several actions of that Committee were confirmed by the Board. All are incorporated herein as actions of the Board.

Approval of Minutes

Minutes of meetings of the Board on July 21, and of the Executive Committee on July 20, were approved.

E. B. Black Nominated for President

Following a meeting of the Nominating Committee, it was announced that the unanimous choice for President of the Society for 1942 was Ernest Bateman Black of Kansas City, and that he had accepted the nomination.

Standards for Letter Symbols Approved

Following recommendation of Society representatives on joint committees to develop letter symbols for engineering terms, two standards under the administration of the American Standards Association were approved as follows: (1) Letter Symbols for Hydraulics; and (2) Letter Symbols for Mechanics of Solid Bodies. Details of these standards will be printed subsequently.

Exchange Effects on Entrance Fees for Foreign Members

The financial procedure applying to dues for foreign members, handicapped by unfavorable exchange rates, was extended also to entrance fees, so that the Society shares with the new member the inequality of exchange.

Hal H. Hale to Represent Society in Washington

To act for the Society with residence in Washington, Hal H. Hale, M. Am. Soc. C.E., of Atlanta, Ga., was chosen, with the expectation he would take up his new duties on November 14. A brief note concerning Mr. Hale appears in another item in this issue.

Joint Representation

In cooperation with other Founder Societies, authorization was given to name Society representatives on committees studying interrelations with South America and post-war economic conditions.

Executive Committees of Technical Divisions

Approving nominations of the various Technical Divisions, new members of the executive committees for five-year terms were appointed, as noted in the November issue, page 678.

Prize Awards Confirmed

Reports received from various committees, recommending prize awards for 1941, were adopted and the prizes were assigned. Note of the Society prizes and the Mead prizes was given in the November issue, pages 676 and 678. Announcement of the Rudolph Hering Medal and the Construction Engineering Prize, will be found on another page in this issue.

Unionization of Engineers

Respondent to a resolution submitted by the Local Section Conference held at the time of the San Diego Meeting, the Board dis-

cussed at some length the problem of unionization reported to be facing engineers, more particularly young engineers, and appointed a committee to study the matter.

New Honorary Members

Canvass was made of ballots for Honorary Membership in the Society, resulting in the election of Ralph Budd, William Kelly, Henry E. Riggs, John Lucian Savage, and Henry Matson Waite, as previously announced in the November issue, page 674.

Committee on Publications

A Progress Report was received from the Committee on Publications; and following its recommendation, approval was given to the renewal of a contract for printing the Yearbook, to be awarded for a five-year term.

Constitutional Amendment—Junior Membership

Notice was given of progress in the formality looking toward the amendment of the Constitution, changing the upper limit in the age of Juniors, and progressively increasing Juniors' dues after the age of 32. The wording of the proposed amendment, for which the required preliminary signatures have been obtained, is given on page 743 of this issue.

Amendment of By-Laws—Election of Members

Notice in regular form was given of a proposed amendment to Section 10 of Article I of the By-Laws, providing that members upon election shall subscribe to the Code of Ethics, and that violation shall be considered cause for expulsion.

Fort Belvoir Local Section

Formation of a new Local Section at Fort Belvoir, Va., was approved, subject to the consent of adjacent existing Local Sections.

Professional Conduct

Two cases of alleged unprofessional conduct were presented, in addition to other matters, from the Committee on Professional Conduct, with appropriate action in each instance.

Districts and Zones

The Committee on Districts and Zones announced that no changes in boundaries were contemplated for the year 1942.

Division Activities

A report was received from the Committee on Division Activities recommending certain changes in the statements of Technical Division objectives and the listing of Technical Division committees. The Board approved such changes for inclusion in the 1942 Yearbook.

Student Chapters

Various recommendations were received from the Committee on Student Chapters, including the following: (1) that a grade of Student Member be not established; (2) that failure to receive accrediting in civil engineering by January 1, 1944, shall be due cause for withdrawing a Student Chapter; (3) that twelve specified Student Chapters should receive letters of commendation from the President; (4) that during the present emergency, minimum membership requirements for Chapters be waived; and (5) that the suggestion to interchange Junior membership among the Founder Societies be disapproved. These recommendations were adopted. Note of the twelve winning Student Chapters was given in the November issue, page 679.

Pan-American Highway Congress

A report was received from the Society's representative to the Fourth Pan-American Highway Congress in Mexico City, September 15–24, 1941. A souvenir medal to the Society from the Congress was accepted with authorization for a letter of appreciation to the officials of the Congress.

Post-War Conditions

A report was received from the Committee on Post-War Conditions. After discussion this was approved and authorized for publication, as issued in the November CIVIL ENGINEERING, page 677.

Problems of Engineering Consultants

The Board discussed the problem of engineers employed by the Government on a consulting basis to design construction other than fortifications. A statement of principles was adopted and approved for publication, as given on page 680 of the November number.

Committee Reports

A number of committee reports, dealing with membership, finances, and such matters were presented for information or approval.

Other Subjects

Miscellaneous matters, relating to administrative and other details, were presented, with appropriate action in each instance.

Adjournment

The Board adjourned to meet in New York City on January 19, 1942.

Division Prizes Announced

Rudolph Hering Medal

By approval of the Board of Direction at its Chicago meeting and in accordance with the recommendation of the award committee of the Sanitary Engineering Division, the Rudolph Hering Medal for 1941 is awarded to Thomas H. Wiggin, M. Am. Soc. C.E., for his "noteworthy, painstaking, and thorough annual reviews of progress, developments, and trends in water supply engineering and water works practices since 1933."

Although this prize is under the special patronage of the Sanitary Engineering Division, it is otherwise handled in the same way as the other Society prizes—that is, it is formally presented at the ceremonies in connection with the Annual Meeting in January.

Construction Engineering Prize

As recommended by the Construction Division and approved by the Board of Direction at its Chicago meeting, the Construction Engineering Prize for 1941 goes to E. L. Durkee, M. Am. Soc. C.E., for his paper, "Erection Methods on Baton Rouge Bridge," in the March 1941 issue of CIVIL ENGINEERING.

This is the third award of the Construction Engineering Prize, the first having been made in 1939. According to regular procedure the prize will be bestowed at the Society's Annual Meeting in January. It will be noted that this prize is separate from the other Society prizes, as it is under the direction of the executive committee of the Construction Division, and is limited to papers appearing in CIVIL ENGINEERING.

Presenting the Index for CIVIL ENGINEERING for 1941

One of the special services rendered by the Society to its members is the issuance of a yearly index to CIVIL ENGINEERING. This appears in the last number for the year—which means that the index for 1941 is to be found in this issue. For those who keep their copies for later use, it is particularly handy, and in any case it provides a means of ready reference to the material that has appeared in CIVIL ENGINEERING throughout the year just ended.

The advantage of having the index come out with the December number, at the end of each volume, is especially evident if the twelve issues are to be bound before the end of the year. The index is printed in a separate form, at the very end of the issue, making it possible simply by unloosening the wire staples to remove it intact, either for filing or for binding. The first page of the index is designed to constitute a fitting title page for the bound volume of twelve issues if the index is bound in at the beginning of the volume. For those who may require them, reprints of the index alone are available at a cost of 15 cents.

From an editorial standpoint, the difficulties of getting the index ready to appear in December, so as to include the number in which it appears, are obvious. However, the appreciation of many members, engineering offices, and libraries, who desire to make immediate use of it, indicates that the additional labor is warranted.

Appointments of Society Representatives

Philip W. Henry, M. Am. Soc. C.E., has been appointed Society representative on the newly organized Joint Conference Committee to establish ways and means for better relationships with the Latin-American countries.

Charles M. Spofford, M. Am. Soc. C.E., chairman; James H. Cissel, Frank M. Masters, and Homer R. Seely, Members Am. Soc. C.E.; and Frederick B. Farquharson, Assoc. M. Am. Soc. C.E., have been appointed members of the Society's Committee on the Tacoma Narrows Bridge.

E.C.P.D. Has Profitable Annual Meeting

THIS YEAR in New York City, on October 30, the Engineers' Council for Professional Development conducted what is considered to be its most successful annual meeting. Business sessions were held at Society Headquarters, in the Board Room, while the annual dinner took place in the evening at the nearby Engineers' Club. A total of nearly 100 members and delegates gathered during the day and for the dinner.

Especially welcome was a group of representatives from the Engineering Institute of Canada, which organization recently joined the Council. The group, which was headed by the current president, Dr. C. J. Mackenzie, and the secretary, L. Austin Wright, included several other prominent members of the Institute, among them J. M. R. Fairbairn, Hon. M. Am. Soc. C.E., J. B. Challies, M. Am. Soc. C.E., E. A. Cleveland, M. Am. Soc. C.E., and Arthur Surveyer, M. Am. Soc. C.E., all past-presidents of the Institute; and J. A. Vance, C. C. Kirby, and H. F. Bennett.

Business Meeting

During the morning, reports were received from the committees of E.C.P.D. A favorable financial situation was reported, including increased support by constituent bodies, so that it is expected that reexamination of engineering curricula may be performed without expense to the institutions concerned, thus eliminating a source of misunderstanding. Continuation of the accrediting procedure and acceptance of the standard of acknowledgment of proficiency was reported. The Council, however, decided not to expand its present membership beyond the society organizations now collaborating.

A new pamphlet, "Engineering as a Career," was reported to have been approved; this gives concisely and in the language of the high school boy, an outline of the engineering profession and what it holds for a prospective member. This takes the place of the former booklet, "Engineering—A Career, a Culture," now out of print. The new guide is expected to be published by E.C.P.D. in the near future.

Other Interesting Features

Short engineering courses provided by the Engineering Defense Training program should not receive credit toward degrees, the Committee on Engineering Schools recommended, pointing out that this would interfere with the primary objective of the courses. The defense program has highlighted the lack in the United States of facilities for technical education of a grade between the engineering college and the vocational school, the committee noted. It announced the appointment of a subcommittee to work with the Society for the Promotion of Engineering Education (S.P.E.E.) to develop a program for accrediting technical institutes.

Attention was called to the increase in engineering schools operated for private profit and granting engineering degrees under existing state laws. A year's study in such schools, in the opinion of the committee, is not equivalent to a year in an accredited institution. The committee also recommended that the E.C.P.D. continue its policy of limiting the variety of engineering curricula accredited, accrediting specialized curricula only as options under accepted general curricula.

Recognition of the fact that the defense program and the probable employment problems following the present emergency will affect the relationship of younger engineers to their professional societies, was indicated in recommendations of the Council's Committee on Professional Training, urging immediate consideration of these problems. This committee also recommended that the national engineering societies hold clinics for professional guidance.

A study of the bases of selection of engineering students to be made jointly by the S.P.E.E. and the E.C.P.D. was recommended by the latter's Committee on Student Selection and Guidance, which continues also to encourage engineers to carry on guidance work among high school students in their communities. As an example of advances in the administration of student guidance programs, particular attention was drawn to the success of the joint committee in the New York metropolitan area.

During the past year, the E.C.P.D. took over the sponsorship of a joint Committee on Engineering Ethics, representing several national engineering societies. Reporting preliminary work in the drafting of a canon of engineering ethics, the committee recommended that a statement regarding the influence of ethics on the basis of a profession be prepared by the Council's Committee on Professional Recognition. The latter committee reported continued study on the problems related to professional recognition.

Views of Societies

Following these reports, representatives of the various member organizations were recognized from the chair for brief statements from the standpoint of their own societies. Of special interest was the strong presentation of Dr. Challies for the Engineering Institute of Canada, received with much enthusiasm. George W. Burpee, M. Am. Soc. C.E., spoke for the Society.

During the executive session in the afternoon, following an open luncheon meeting at the Engineers' Club, matters of inspection and accrediting of engineering schools and similar topics were discussed. Nearly all the institutions in the United States which grant degrees in engineering have voluntarily submitted curricula for inspection by the Council's Committee on Engineering Schools since the beginning of the accrediting program in 1933, the committee's report shows. In 143 of 166 such institutions, 896 curricula have been inspected, including reinspection, since 1939, of 157 curricula. One or more curricula have been accredited in 129 schools. Accredited curricula number 461; provisionally accredited, 104; action was deferred on 6; and accrediting has been refused to 167. Reinspection resulted in a change of status for only 26 curricula. With the inspection program virtually complete, the committee is now engaged chiefly with reinspections of curricula that had been provisionally accredited.

Officers Chosen

Officers for the year 1941–1942 were elected as follows: R. E. Doherty, president of Carnegie Institute of Technology, Pittsburgh, Pa., was elected chairman for a second term; H. T. Woolson, executive engineer, Chrysler Corporation, was reelected vice-chairman. H. H. Henline, national secretary, American Institute of Electrical Engineers, New York, N.Y., was elected secretary; and A. B. Parsons, secretary, American Institute of Mining and Metallurgical Engineers, New York, N.Y., assistant secretary.

Newly elected committee chairmen are: D. B. Prentice, president, Rose Polytechnic Institute, Terre Haute, Ind., Committee on Engineering Schools; E. S. Lee, engineer, General Engineering Laboratory, General Electric Company, Schenectady, N.Y., Committee on Professional Training; G. Ross Henninger, editor, American Institute of Electrical Engineers, New York, N.Y., Committee on Information. The following committee chairmen were reelected for the coming year; R. L. Sackett, M. Am. Soc. C.E., dean emeritus of engineering, Pennsylvania State College, New York, N.Y., Committee on Student Selection and Guidance; C. F. Scott, professor emeritus of electrical engineering, Yale University, New Haven, Conn., Committee on Professional Recognition; D. C. Jackson, M. Am. Soc. C.E., professor emeritus of electrical engineering, Massachusetts Institute of Technology, Cambridge, Mass., Committee on Engineering Ethics.

Addresses Follow Dinner

In the evening, following the dinner, a number of guests and representatives were introduced, after which there was a prepared program of three features. The first was by N. W. Dougherty, M. Am. Soc. C.E., dean of engineering, University of Tennessee, whose topic was the "Relation of E.C.P.D. to Engineer Registration Boards." He was followed by A. H. White, chairman of the department of chemical and metallurgical engineering at the University of Michigan, current president of S.P.E.E., who spoke on the "Relation of S.P.E.E. to E.C.P.D." Finally, James F. Fairman of the Consolidated Edison Company of New York and representative on the Council of the American Institute of Electrical Engineers, completed the trilogy with an address on the "Relation of E.C.P.D. to Engineering Societies." This program, which held the interest of all who attended, completed the ninth annual meeting of the E.C.P.D.

Pervading the meeting was a spirit of optimism and progressive thinking. It was evident that the E.C.P.D. has made an enduring place for itself and is supplying a definite service to the profession. Confidence of even greater progress gave encouragement for the future.

Appraising the Vinson Bill

Society's Counsel Analyzes Measure That Affects Engineers on Defense Work

The so-called "Vinson Bill," H.R. 5781, introduced into the House of Representatives on October 7, 1941, and referred to the Committee on Ways and Means, has caused considerable concern among the engineers and architects engaged on defense contracts.

To determine with authority the inequities apparently resident in the Bill as applied to engineers, and the effect its passage could have upon them, the Society's Counsel was asked for an opinion. This is presented here in full for the benefit of Society members.

Individual engineers, or partnerships of engineers, which, in the light of Counsel's opinion, interpret themselves to be adversely affected, are urged to advise the Secretary of the Society. They should give details as to each specific instance in which they would be involved, and an indication of the effect that the passage of the bill would entail with respect to them.

PARKER & AARON
20 Exchange Place
New York

November 22nd, 1941

George T. Seabury, Esq., Secretary
American Society of Civil Engineers
29 West 39th Street
New York City

Re: *Vinson Bill*

Dear Mr. Seabury:

I have given considerable thought to the questions which have been raised concerning the so-called Vinson Bill, being H.R. 5781 introduced in the House of Representatives on October 7th, 1941, by Mr. Vinson of Georgia, and referred to the Committee on Ways and Means.

In this letter the matter is approached only from the standpoint of an individual or partnership, and I do not attempt to discuss the proper construction of this Bill in so far as it affects corporations. A corporation as such, generally speaking, does not directly conduct professional engineering, and the effect of the Bill upon corporations is quite different from its effect upon individuals and partnerships.

The purpose of the Bill is stated to be:

> "To provide for the recapture of excessive profits derived from national-defense contracts."

The procedure planned by the Bill to effect such recapture is not in form the imposition of a tax upon profits, but a statutory requirement that,

"Every defense contractor shall pay into the Treasury, at the time or times fixed by law for the payment of such contractor's tax under chapter 1 of the Internal Revenue Code, all net profits derived from defense contracts, completed within the taxable year in respect of which such tax is payable, in excess of 7 per centum of the cost, determined as provided in section 4, of performing such contracts. . . ."

A defense contract is defined in the Bill as follows:

"Sec. 2. . . .

"(*b*) 'Defense contract' means—

"(1) a contract with the United States entered into on behalf of the United States by an officer or employee of the Department of War, the Department of the Navy, or the United States Maritime Commission;

"(2) a contract with the United States entered into by the United States pursuant to an Act to promote the defense of the United States;

"(3) a contract, whether or not with the United States, for the design, survey, production, manufacture, processing, assembly, construction, reconstruction, installation, maintenance, storage, repair, alteration, conversion, distribution, or supply of—

(*A*) any weapon, munition, aircraft, vessel, or boat;
(*B*) any building, structure, or facility;
(*C*) any machinery, instrument, tool, material, supply, article, or commodity; or
(*D*) any component material or part of or equipment for any article described in subparagraph (*A*), (*B*), or (*C*);

the design, survey, production, manufacture, processing, assembling, construction, reconstruction, installation, maintenance, storage, repair, alteration, conversion, distribution, or supply of which by the defense contractor in question is certified by the President to such contractor and to the Commissioner of Internal Revenue as being contracted for for national-defense purposes;

"(4) a contract, whether or not with the United States, for the furnishing of professional or technical services, the furnishing of which is certified by the President to such contractor and to the Commissioner of Internal Revenue as being contracted for for national-defense purposes. . . ."

A defense contractor is defined in the Bill as follows:

"Sec. 2. . .

"(*c*) 'Defense contractor' means the person designing, surveying, producing, manufacturing, processing, assembling, constructing, reconstructing, installing, maintaining, storing, repairing, altering, converting, distributing, supplying or furnishing professional or technical services, under a defense contract."

Under the foregoing definitions, a member of your Society entering into a contract to furnish professional services, would be subject, as to that contract, to liability for excess profits, as defined in the Bill, in the following cases:

(*a*) Where the contract was made by an officer or employee of the Department of War, the Department of the Navy, or the United States Maritime Commission;

(*b*) Where the contract was made with any Department of the United States Government "pursuant to Act to promote the defense of the United States";

(*c*) In any contract described in Subdivision 3 (of subdivision (*b*) of Sec. 2, above quoted), where the President certified to the contractor and to the Commissioner of Internal Revenue that the contract was made for national defense purposes.

With regard to the cases where the contract is made directly with the United States or a subdivision thereof, the application of the requirement respecting excess profits is reasonably certain. With respect to the remaining cases, where there must be a cerificate by the President of the United States, the Bill lays down no particular procedure for such certificate, or for the cases in which the President may so certify, nor does the Bill provide whether such certificate is to be made before the contract is let, at the time of the letting of the contract, or at some time thereafter. The language, "as being contracted for for national-defense purposes," would seem to imply a certificate made before or at the time of letting the contract. If the certificate could be made at any time after the contract was let, a more appropriate language would be, "as having been contracted for," rather than "as being contracted for," but the legal significance of the words used in the Bill would seem to be sufficient to include the case of a certificate issued after the contract had been let, particularly when taken in connection with the provision in Section 7 of the Bill that it shall apply to "defense contracts completed within taxable years beginning after December 31, 1940." Under this provision it would seem that where the contract was completed after December 31, 1940, the President could issue a certificate, and I therefore must assume in discussing the Bill that the President could issue a certificate with respect to any contract coming within the definition of a "defense contract," at least at any time prior to the due date of the tax or payment required by the Bill.

So much for the definition of the types of contract included in the scope of the Bill, and the contractors' liability thereunder.

I next discusss the basis on which the excess profits is to be calculated. With respect to individuals and partnerships, a fundamental factor in this calculation is the provision in subdivision (*c*) of Section 4, reading as follows:

"(*c*) Irrespective of the method employed by any defense contractor for determining costs of performing defense contracts completed within any taxable year, no item of cost shall be charged to the performance of any such contract or used in any manner for the purpose of determining the cost of such performance unless for such taxable year, or for a previous taxable year for which gross income from any one or more of such contracts is properly returnable,

such item has been claimed and is allowable under section 22 (*c*) of the Internal Revenue Code in computing gross income or has been claimed and is allowable as a deduction from gross income under section 23 of the Internal Revenue Code. . . ."

By reason of this provision, a partnership or an individual engineer could make no deduction for the reasonable cost or value of his personal services as an item of the cost of performance on a defense contract to which he was a party, because such an item is not deductable from gross income under section 23 of the Internal Revenue Code. In other words, when an engineer is making his personal income tax return he may not deduct from his gross income the fair value of professional services rendered by him, and present an income or profit based upon the fee which he receives, less the fair value of his services. The result of this provision is that an engineer who renders professional services under a defense contract of employment may deduct as cost only what he has actually expended in the performance of the contract. For example: Assuming that an engineer has agreed to furnish supervision, advice and counsel with respect to the design and construction of a defense building and plant which is to cost $5,000,000.00 and his fee is fixed at 1% of the construction cost, or $50,000.00; and assuming that the nature of the services required by him called principally or wholly for personal advice and inspection, criticism of plans prepared by the contractor, etc., but did not involve any substantial office expenditure by him directly applicable to the work, substantially all of his fee is excess profit, and he is entitled to retain therefrom only 7% of the actual cost to him of furnishing his services, excluding any element of the value of his personal time or loss of income due to his engaging in the defense contract instead of taking employment in other matters. He could not deduct from the $50,000.00 fee received, on which he would have to pay an ordinary Federal income tax, but would be entitled, under Section 5 of the Bill, to a credit for so much of his personal income tax as was based upon the inclusion in his total income of the amount that he had to pay under Section 3 of the Bill.

It is obvious that the practical result of the adoption of the Bill would be that professional engineers would receive no substantial compensation for services rendered in defense contracts.

I cannot believe that when this effect of the Bill is disclosed there is any likelihood of its adoption. Certainly, the defense program is essentially dependent upon engineering services and the contribution of the professional engineer to the defense program is not less important than that of any other possible factor. A statute which would, in effect, provide that engineers should not be paid for their services on defense contracts is so far from any reasonable or effective governmental policy that comment is unnecessary. For this reason I do not discuss at any length the constitutional objections which might be raised to the Bill.

In so far as it is applicable to contracts which were partly but not wholly completed prior to December 31st, 1940, it is clearly objectionable as retroactive to an unwarranted degree. With respect to this matter, of course the United States Supreme Court has frequently applied the principle that it is not objectionable to an income tax provision that it is retroactive within a reasonable period which might well be within the contemplation of the taxpayer. For example, the Court has sustained the validity of an income tax statute passed in the middle of a year to apply to all income received during the calendar year. In a case, however, where a contract was made for employment in the year 1938, and income tax paid on income received under that contract during that year, and a similar situation continued during 1939 and 1940, a statute which now went back and imposed a confiscatory tax on the income received in 1938, 1939, and 1940 on the sole ground that a small portion of the contract was finished after 1940, would probably exceed any permissible retroactive effect, and would be unconstitutional on that ground.

A further ground of attack might be that the statute unreasonably discriminated between independent contractors and persons performing the same services as employees of a corporation. For example, an engineer, Mr. Smith, makes a contract as an independent contractor to furnish services in connection with a defense contract, and becomes subject to the provisions of the Bill and can receive practically no compensation for his work. If, however, he accepts employment as an officer of a corporation performing a defense contract, at a salary of, say, $50,000.00 a year, and makes no independent contract concerning any particular defense contract, but his services are utilized by the corporation in the performance of the defense contract, in the latter event his salary is an allowable item of the corporation in computing the cost of the contract and the salary is received by the officer-engineer and is not subject to the requirements of the Bill. While here, again, the taxing authority has very wide discretion in classifying taxes, still there must exist some reasonable basis of distinction which would seem to be absent in the Bill under discussion.

The foregoing points are merely suggested and not developed, for the reason that I feel confident that the Bill, in its present form, will not survive the Committee stage.

With personal compliments,

Very truly yours,
(*Signed*) CHARLES ADKINS BAKER

Cabinet Meeting Held by Iowa State College Student Chapter

Excerpts from 1940–1941 Annual Report of Chapter

IN THE past history of the Student Chapter at Iowa State College, it has been the policy of the officers to have a cabinet meeting each Wednesday afternoon at five. During the past year the same meetings—attended by the president, vice-president, secretary, treasurer, junior and senior representatives to the engineering council, Faculty Adviser, and Junior Contact Member—were held with much success. The interest of the officers in the Chapter was such that having the meetings regularly each week did not seem superfluous. At this time the problems of the society were discussed, and plans for the coming meetings and other projects were made. Since the student members of the Chapter are less closely connected with the inner workings of the Chapter, it is only right that a large part of the policy forming should be carried on in cabinet meetings subject, of course, to the approval of the members at regular Chapter meetings.

It is much easier to maintain interest among the cabinet members, and consequently among the students in general, if the president has each cabinet meeting planned ahead with the details of business outlined. The meeting will proceed briskly. It is a poor policy for the president to take a problem to the Faculty Adviser or other cabinet member alone and decide an issue without the knowledge of the rest of the cabinet, unless the problem must be settled at once and a special meeting cannot conveniently be called. All questions, no matter how small, should be brought to the attention of the cabinet. The importance of the question should determine the length of time devoted to its discussion, rather than whether or not it is to be discussed in cabinet meeting. The president should also be able to sense anything that is going wrong in meetings, both cabinet and Chapter, and figure out, perhaps with the help of the Faculty Adviser, a satisfactory solution.

Another factor that is of utmost importance, especially with the cabinet meetings, is the regularity of the meeting time. It is much easier to have meetings at a regular time every week than to call special meetings whenever it is deemed necessary. The cabinet members will form the habit of coming each week at a certain time and will not have any other plans made for that time, thus eliminating the conflicts a special meeting always encounters.

It is the duty of the president to keep the meeting going, anticipating what is to be done in the future and bringing such matters to the attention of the cabinet. It is much better so look ahead to future business at a short meeting than to skip a meeting or two and break a habit that has been formed.

At times the cabinet meetings will be dragged out into long rambling discussions that run past stopping time. When the president foresees this situation, it is his duty to cut all discussion short and to bring up only issues that must be discussed at that particular meeting. The other items can wait until another meeting. It has been found, for instance, that the Faculty Adviser, intensely interested in some particular problem, may monopolize too much time, not realizing that there are other important issues to be handled before the meeting closes. When members of the cabinet do this, the president must bring the discussion to a close with a statement that there is little time left and other business to be considered.

Proposed Constitutional Amendment re Juniors

For some time the question of advisable changes in the Constitutional requirements regarding Juniors has been considered by the Committee on Membership Qualifications. For instance, it was noticed that the depression had made it increasingly difficult for Juniors to acquire the grade of Associate Member by the time they had reached the age of 33. The draft may further increase this handicap. Rather than lower the requirements for Associate Member, it was considered desirable to extend the period of Junior membership.

To do this without further change would mean that Juniors would continue to enjoy many Society benefits without paying proportionately for them. It was therefore thought that coincident with the extension of the age limit, there should be a corresponding increase in dues.

The changes in the Constitution now proposed involve, first, an extension in the age limit of Juniors; and second, a sliding-scale advance in the dues of Juniors after they reach the age of 32 until they transfer to Associate Membership, or failing transfer, cease to be members at the age of 35. The proposed amendment to the Constitution was initiated by the Board of Direction, and the name of each Board member is among the large number of petitioners. The necessary 75 signatures from each of the four Zones have been secured and the amendment is thus officially brought before the Society.

This amendment will be a matter for consideration at the business session on Wednesday morning of the Annual Meeting, where it may be ordered passed to ballot, without amendment, or amended and ordered passed to ballot as amended, or it may be ordered referred to a committee for report to the Society at the business session of the Annual Convention to be held in Spokane, Wash., in July next.

The amendment reads as follows:

Amend Article II—Membership

Amend Section 7, by substituting the words "thirty-five" for the words "thirty-three" in the first paragraph of the Section.

The first paragraph of this Section as amended will then read:

"7. A Junior, at the time of his admission, shall have had active practice in some branch of engineering for at least four years, or he shall have been graduated in engineering from a school of recognized standing. He shall be not less than twenty years of age, and his connection with the Society shall cease when he becomes thirty-five years of age unless he be previously transferred to the grade of Associate Member."

Amend Article IV—Dues

Amend Section 2 by adding the words: "prior to the age of thirty-two, thereafter increasing at the rate of two dollars and fifty cents per year, for three years."

The Section as amended will then read:

"2. The annual dues payable by members, except those in District 1, shall be as follows: by Corporate Members, twenty dollars; Affiliates, twenty dollars; Juniors, ten dollars prior to the age of thirty-two, thereafter increasing at the rate of two dollars and fifty cents per year, for three years."

Amend Section 3, by adding to the first paragraph "prior to the age of thirty-two, thereafter increasing at the rate of two dollars and fifty cents per year, for three years" and to the second paragraph "prior to the age of thirty-two, thereafter increasing at the rate of two dollars and fifty cents per year, for three years."

The Section as amended will then read:

"3. In District No. 1 as hereinafter constituted the annual dues, except for members residing outside of North America, shall be as follows: Corporate Members, twenty-five dollars; Affiliates, twenty-five dollars; Juniors, fifteen dollars prior to the age of thirty-two, thereafter increasing at the rate of two dollars and fifty cents per year, for three years.

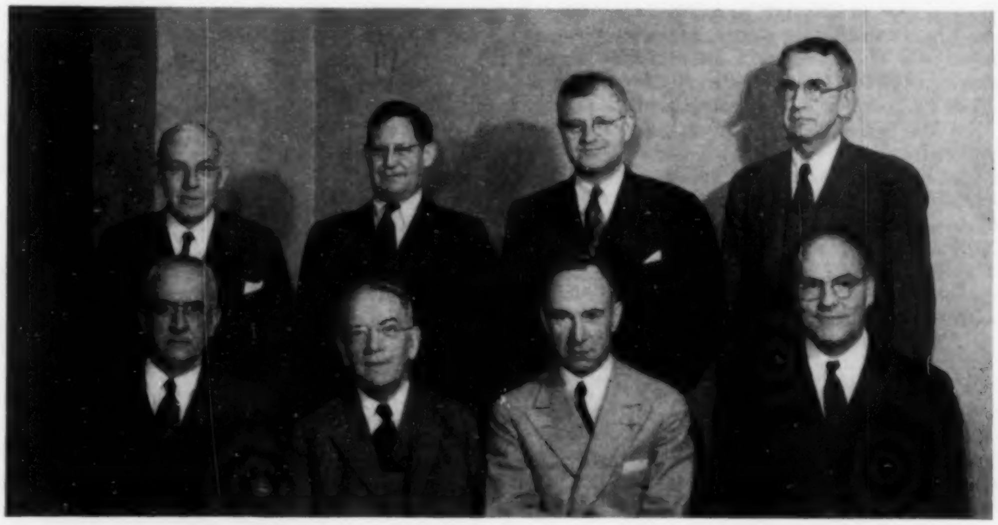
"Members residing outside of North America shall pay annual dues as follows: by Corporate Members, twenty dollars; Affiliates, twenty dollars; Juniors, ten dollars prior to the age of thirty-two, thereafter increasing at the rate of two dollars and fifty cents per year, for three years."

Joint Conference Committee Meets

In Indianapolis on October 11, a meeting was called of the presidents and secretaries of the four Founder Societies. This group constitutes what is known as the Joint Conference Committee, whose purpose, as the committee has defined it, is to promote cooperation and to eliminate conflict among the four societies in matters of policy.

To this end, ideas were exchanged regarding a variety of mutual problems, such as a possible joint office in Washington, activities of the Engineers' Defense Board, and the assistance of engineers in promoting friendly relations with South America. Much discussion was given to the engineering proposals to alleviate post-war economic difficulties, with the result that machinery was set up to study various possibilities.

Officers were chosen to serve through 1942, as follows:



Officers of the Four Founder Societies Meet in Indianapolis, Ind., as Joint Conference Committee

From Left: Seated, Frederick H. Fowler, President, and behind him George T. Seabury, Secretary, of the American Society of Civil Engineers; Second, Howard N. Evanson, Past-President (representing John R. Suman, President), and behind him A. B. Parsons, Secretary, of the American Institute of Mining and Metallurgical Engineers; third, William A. Hanley, President, and behind him, C. E. Davies, Secretary, of the American Society of Mechanical Engineers; fourth, David C. Prince, President, and behind him, H. H. Henline, Secretary, of the American Institute of Electrical Engineers

Chairman—President, American Society of Mechanical Engineers (William A. Hanley, to be succeeded by James W. Parker)

Vice-Chairman—President, American Institute of Electrical Engineers (now David C. Prince)

Secretary—Secretary, American Institute of Electrical Engineers (H. H. Henline)

The accompanying photograph is one of the few in which the official representatives of all four Founder Societies have been included.

Hal H. Hale Becomes Society Representative in Washington

PREPAREDNESS, in addition to normal government business, has made Washington an engineering center. Impressed with the fact that the Capital is witnessing an increasing fever of activity, the Board of Direction felt that the Society should have a resident representative. It therefore appointed for this position Hal H. Hale, M. Am. Soc. C.E. This action was taken at the Chicago meeting of the Board, and Mr. Hale began his work November 14.

HAL H. HALE, M. AM. SOC. C.E., SOCIETY REPRESENTATIVE AT WASHINGTON, D.C.

In training as well as in experience, Mr. Hale is a product of the southeastern region of the United States. He was born and educated in Tennessee. Following graduation from the University of Tennessee, he held positions for short periods in Chattanooga and Atlanta. He then returned to Knoxville, where he entered the employ of the city, remaining for more than ten years and serving for about half this time as city engineer. Still in Knoxville, he worked for a short period in 1938 on the staff of the TVA. He then moved to Atlanta, Ga., where for the past $3^1/_2$ years he has been office engineer for the Atlanta district of the Portland Cement Association.

Throughout his professional life, Mr. Hale has been much interested in Society work. His membership dates from 1925, when he became a Junior. Wherever he has been located, he has done more than his bit in working to advance Society interests. He was secretary-treasurer of the active Tennessee Valley Section from 1934 to 1938. Although he had been in Atlanta a relatively short time, he became president of the Georgia Section in 1941. Largely because of his enthusiasm, Atlanta was selected as the meeting place for the 1942 Fall Meeting. Currently he is a member of the Society's Committee on Local Sections.

On the personal side, Mr. Hale is industrious, friendly, and diplomatic. His function in Washington will be to keep the Board informed on matters pertaining to civil engineers in all their fields of operation and to assist in the carrying out of procedures adopted by the Board. He is not to act as a job getter for either individuals or concerns, nor as a general information bureau. Through Mr. Hale the Board has confident hope of multiplying the services rendered by the Society both to the country and to the profession.

Fall Meeting of the Texas Section

THE three-day fall meeting of the Texas Section got under way in Fort Worth on Thursday, October 30, with the usual pre-meeting entertainment for those who arrived early. C. M. Davis was in charge of the program, which included an enjoyable floor show and informal get-together.

On Friday morning the first technical session was called to order by Joseph Rady, president of the Fort Worth Branch of the Section. Following an address of welcome by George Kimble, who paid tribute to the engineers of Fort Worth for their development of the city, a technical program was presented. The speakers were George F. Harley, whose subject was "Defense Public Works Under the Lanham Act"; C. J. Harkrider, city plan engineer of Fort Worth, who discussed city planning in Los Angeles County; Uel Stephens, assistant regional director of the PWA for Region 8, who read a paper on "Priorities for Construction Materials"; and J. C. Douglas, state director of the Public Work Reserve, whose subject was "The Public Work Reserve and the Engineering Profession."

Guests at the luncheon that noon included Frederick H. Fowler, President of the Society, and three students from Latin-American countries—Rafael Negrette, Hector M. Calderon, and Juan Pedretti. During the business session held later in the afternoon Mr. Fowler spoke briefly, expressing his pleasure in having the Latin-American engineers present. Various committee reports were read and discussed, and H. N. Roberts, president of the Texas Section, reported on the recent Congress of Engineers in Monterrey, Mexico. The annual election of officers resulted as follows: E. C. Woodward, president; R. F. Dawson and C. M. Blucher, vice-presidents; and John A. Focht, secretary-treasurer. The business session was preceded by a technical program consisting of a paper on the "Selection of Materials and Design of Flexible Bases." This was given by J. Neils Thompson, research engineer for the Texas State Highway Department.

The dinner dance, held that evening on the roof of the Texas Hotel, was widely enjoyed. President Fowler made a brief speech, which was followed by dancing and a floor show. The usual breakfast complimentary to the students attending the meeting took place Saturday morning, with Datus E. Proper, chairman of the local Committee on Student Chapters, in charge. Later the session was turned over to Marvin Merrick, Student Chapter member from Southern Methodist University, who presided. The program featured a talk by President Fowler.

At the Saturday morning technical session Charles O. Quade presented a paper on "The Fort Worth Aircraft Assembly Plant." Mr. Quade, who is associate engineer for the U.S. Engineer Office at Denison, Tex., discussed the design of the plant, which is now being constructed. The airplane parts are to be manufactured in the north and shipped to the plant by rail and truck for assembly. A supplementary paper on the project was then read by A. D. Engle, of the Austin Company. Later Mr. Engle conducted the engineers about the plant and answered numerous questions.

News of Local Sections

Scheduled Meetings

CENTRAL OHIO SECTION—Dinner meeting at Pomerene Hall, Ohio State University, on December 11, at 6 p.m.

CLEVELAND SECTION—Luncheon meeting at the Guild Hall Restaurant on December 1, at 12:15 p.m.

GEORGIA SECTION—Luncheon at The Atlanta Athletic Club on December 8, at 12:30 p.m.

ILLINOIS SECTION—Dinner meeting of the Junior Section at the Central Y.M.C.A. on December 2 and 15, at 6 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on December 17, at 8 p.m.; informal dinner meeting of the Junior Branch at the Bristol Hotel on December 10, at 6:30 p.m.

LOS ANGELES SECTION—Annual dinner at the University Club on December 10, at 6:15 p.m.

MIAMI SECTION—Dinner meeting at the Alcazar Hotel on December 4, at 7 p.m.

NASHVILLE SECTION—Dinner meeting at Kissam Hall, Vanderbilt University, on December 2, at 6:30 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Minnesota Union on December 1, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on December 9, at 6 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.; dinner meeting of the Junior Forum on December 10, at 6 p.m.

ST. LOUIS SECTION—Dinner meeting at the Forest Park Hotel on December 12, at 6:30 p.m. (Held jointly with Student Chapters at the University of Missouri, Washington University, and Missouri School of Mines.)

SAN FRANCISCO SECTION—Annual meeting at the Engineers Club of San Francisco on December 16, at 5:30 p.m.

SPOKANE SECTION—Luncheon meeting at the Davenport Hotel on December 11, at 12 noon.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section on December 16, at 5:45 p.m. (Christmas party.)

TEXAS SECTION—Luncheon meeting at the Dallas Athletic Club on December 1, at 12:10 p.m.

Recent Activities

Cincinnati Section

The Cincinnati Section met with the Society of Automotive Engineers, the Engineers' Club of Cincinnati, and the local group of the American Society of Mechanical Engineers for a joint inspection trip, dinner, and technical program at the Lockland plant of the Wright Aeronautical Corporation on October 17. Following an afternoon inspection trip and dinner, the various engineers and officials responsible for the construction of the plant were introduced, after which Rudolph F. Gagg, assistant to the general manager of the Wright Corporation, spoke. Mr. Gagg gave a detailed history of the construction of the plant from its inception a little over a year ago to its recent completion, illustrating his talk with slides showing the various stages of the work. The attendance totaled well over 600.

Colorado Section

On October 13 the members of the Colorado Section heard Frederick K. Carstarphen discuss the "Restoration of the Cripple Creek Volcano and the Carlton Tunnel." Mr. Carstarphen, who is a Denver consultant, gave proof sustaining his theory of the geology of the Cripple Creek District and pointed out the importance of the Carlton Tunnel Project to the future development of the region.

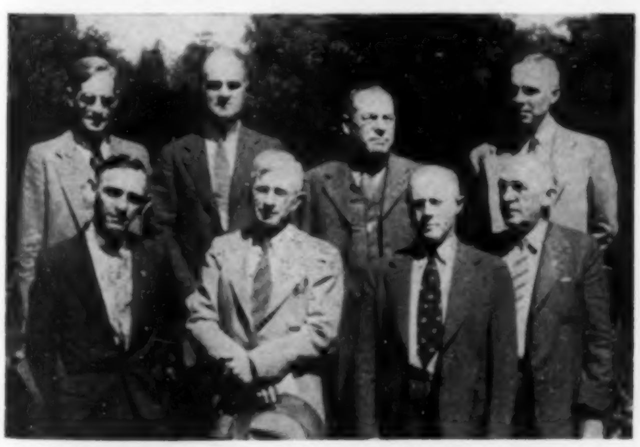
Connecticut Section

At the meeting on October 30 Charles Rufus Harte, engineer for the Connecticut Company of New Haven, discussed a historical pamphlet on the Farmington Canal, published by the State Department of Education. Mr. Harte stated that he found much of the information in the final bulletin incorrect and urged that the pamphlets receive careful checking before they are released to school children. George L. Lucas, Vice-President of the Society, was then introduced and discussed the activities of the Society. A talk on steel columns by Hardy Cross, professor of civil engineering at Yale University, concluded the program.

Georgia Section

A talk on the construction of the Quartermaster Depot at Conley, Ga., was the feature of the first meeting of the fall season, which took place on October 6. The speaker was Maj. S. C. MacIntire, who is in charge of the construction of the project. Much interest was aroused by Major MacIntire's discussion of the problems encountered in a project of such tremendous size.

Already the Georgia Section is busy planning for the 1942 Fall Meeting of the Society, which is to be held in Atlanta. The personnel of a preliminary conference, which recently took place in Atlanta, is shown in the accompanying photograph. In addition to those shown, the conference also included Hal H. Hale, then president of the Georgia Section, who took the photograph.



Group Attending the Conference on the 1942 Fall Meeting

Front Row, Left to Right: Roy S. Garrett, President of the Alabama Section; E. L. Clarke, President of the South Carolina Section; Samuel Young, Chairman of the Program Committee for the Meeting; and W. A. Hansell, Chairman of the Sanitary Committee for the Meeting. Back Row, Left to Right: W. A. Spell, Vice-President of the Georgia Section; Erwin Harsch, President of the Tennessee Valley Section; Col. D. H. Barber, Member of the Board of the Alabama Section; and W. T. St. Clair, President of the Nashville Section

Kentucky Section

The program at the meeting held in Lexington on October 24 consisted of a symposium on engineering education. The practicing engineer's viewpoint was presented by F. W. Droste, assistant engineer for the Chesapeake and Ohio Railroad, while the engineering educator's views were discussed by W. B. Wendt, professor of civil engineering at the University of Louisville. A talk on the views of a member of the State Board of Registration for Professional Engineers concluded the symposium. This was given by C. S. Crouse, secretary of the Kentucky State Board of Registration for Professional Engineers.

Los Angeles Section

Colored motion pictures showing astonishing developments in methods of working on energized electric power lines of extremely high voltage were presented at the October 8 meeting. The film, which was entitled "Hot Line Maintenance," was shown by C. A. Fishback and Fred B. Doolittle, members of the staff of the Southern California Edison Company. Then D. F. Stevens, editor of *Western Construction News*, discussed current engineering and construction activities in the Pacific Coast region.

Concurrently the Junior Forum of the Section met for a discussion of the topic, "Engineering Opportunities in City Service." The discussion was led by Charles W. Doud, senior personnel technician of the Los Angeles City Civil Service Commission.

Metropolitan Section

At the first meeting of the fall season, which was held in New York on October 15, members of the Section heard a timely talk on "Protective Concealment." This was given by Peter Rodyenko, major, Corps of Engineers, U.S. Army, who is officer in charge of camouflage activities for the 2d Corps Area. In a talk that elicited much enthusiastic discussion Major Rodyenko outlined the general principles involved in the industrial applications of camouflage as a passive defense measure and explained that protective concealment is now recognized as a technique based on definitely established scientific facts. Numerous slides were used to illustrate the theories and results upon which the modern practice of concealment is based.

Michigan Section

An unusually large attendance turned out for the first meeting of the season, which was devoted to the theme of "Civilian Defense During Wartime." The principal speaker at this session, which took place in Detroit on October 17, was Glenn C. Richards, secretary of the Detroit Department of Public Works and a member of Mayor LaGuardia's committee to study conditions in war-torn England. Most of the damage, Mr. Richards explained, was caused by fire resulting from incendiary bombs. He then discussed the interruption of public utilities by bombing and the quick restoration of these services by "flying squads" of specially trained workmen. The second speaker was Col. Harold A. Furlong, administrator of the Michigan Council of Defense, who explained the difficulties the Council is having in attempting to set up a program with only a limited amount of state money available for the purpose. The full cooperation of the Section in the work of the Council was promised Colonel Furlong by Luther R. Hoffman, member of the Section and chairman of the Michigan Defense Committee. During the meeting it was announced that the following officers have been elected for the coming year: Lewis C. Wilcoxen, president; Milton P. Adams, first vice-president; George W. Francis, second vice-president; and Clair C. Johnston, secretary-treasurer.

Mohawk-Hudson Section

The topic of discussion at the dinner meeting of the Section, which took place in Albany, N.Y., on October 2, was "Control Surveys Based Upon a State-Wide Plane Coordinate System." G. R. Shaw, assistant professor of geodesy at Rensselaer Polytechnic Institute, introduced the subject with a description of the systems used, the methods of extending the control net, and the adoption of the system for the work of the individual surveyor. During the ensuing discussion it was generally agreed that the practical

adoption of the system for general surveying operations can be brought about only by the continued efforts of engineers to bring the economic and technical advantages to the attention of the people of the state.

Northeastern Section

The annual Student Night, sponsored jointly by the Section and the Boston Society of Civil Engineers, took place on October 15. There was a large student attendance from all the Chapters in the Section. The feature of the technical program was an illustrated lecture on the construction of the Quonset (Rhode Island) Naval Air Station, the speaker being R. V. Miller, commander, Civil Engineer Corps, U.S. Navy. Commander Miller, who was officer in charge of construction, emphasized the record time in which the base was constructed and described the magnitude and scope of the project.

Oregon Section

"Civilian Defense in England" was discussed at the October 9th meeting of the Oregon Section. The first speaker was Edward Boatright, coordinator for the City of Portland and the County of Multnomah Civilian Defense Council. He was followed by Alfred Cormack, London manager of the Jantzen Knitting Mills, who told of some of his experiences during the recent London air raids.

Philadelphia Section

On October 14 Shortridge Hardesty, New York City consultant, spoke on the design and construction of the Rainbow Bridge at Niagara Falls, on which his firm was engaged. Mr. Hardesty gave a brief historical review of the bridges that preceded the Rainbow Bridge and discussed the details of design. The procedure used in erection of the structure was then described by E. L. Durkee, resident engineer for the Bethlehem Steel Company on the project. Motion pictures of the actual erection procedure concluded the technical program. Of special interest were the setting of the top piece on the temporary steel tower for support of tiebacks, and the system used in getting the ties out to point of support on the arch rib. Lester L. Lessig was chairman of the committee in charge of arrangements for the evening.

San Francisco Section

A symposium on "Local Activities of the Civil Engineer Corps, U.S. Navy," was presented at the meeting on August 19 by a panel of officers from the Civil Engineer Corps. Those taking part were Capt. H. G. Taylor, Public Works Officer for the Twelfth Naval District; Lt. Comdr. L. J. Archer, officer in charge of construction of the Oakland Supply Depot; and Lt. J. F. Jelley, Jr., officer in charge of construction of the Alameda Naval Air Station. The two latter speakers described the projects with which they were connected, while Captain Taylor outlined the Navy's program of expansion ashore.

At the meeting on October 21 the program dealt with "The East Bay Cities Sewage Survey," the speakers being Society Director Charles G. Hyde and Harold F. Gray, sanitary and hydraulic engineer of Berkeley. The former reviewed the recent survey covering the collection, treatment, and disposal of sewage from Oakland and six neighboring cities on the east shore of San Francisco Bay, while Mr. Gray described the existing sewage systems and outlined the extensive studies that have been made of the treatment and disposal of domestic, storm, and industrial wastes which, with the present outfalls, collect on the mud flats.

Seattle Section

Different points of view on engineering education were presented in a symposium comprising the technical program on September 29. Those taking part were E. R. Wilcox, professor of general engineering at the University of Washington; L. R. Turnbull, engineer of personnel and accounts for the Washington State Highway Department; and John P. Hart, president of the Hart Construction Company and member of the State Board of Engineering Examiners. The consensus of opinion was that more cultural subjects should be added to the present engineering curricula as approved by the Engineers Council for Professional Development, and that some means of giving the student practical experience before his graduation is highly desirable.

A talk on "Nine Years' Construction Work in the Hawaiian Islands" was the feature of the October meeting. This was given by E. L. Hageman, formerly of Hawaii and now office engineer for the Austin Company on the construction of the Sand Point Naval Air Station at Seattle. Mr. Hageman stated that the story of engineering in the Islands is mainly the story of securing an adequate water supply, the three main sources being reservoirs for the collection of surface water, tunnels that tap water trapped between vertical dikes in the lava mountains, and artesian wells whose source of supply is also the water held between the lava dikes in the mountains. Slides of road and building construction in Hawaii completed the program.

Spokane Section

The Spokane Section devoted its September meeting to a discussion on "Civilian Protection in Wartime." The topic of sanitation and public health was covered by T. H. Judd, while Alex Lindsay, recently returned from a meeting of the National Water Works Association in Toronto, discussed the reaction of a country at war to the protection of these facilities. Walden L. Malony, consulting engineer of Spokane, spoke on bomb-proof shelters, pointing out in this connection that natural or underground shelters have proved most effective. He, also, stated that buildings of the wall-bearing type are quite susceptible to destruction, while column and frame structures offer better resistance. Data were given on the penetration of bombs of different weights on buildings, and it was stated that the War Department has constructed a test building in order to study bombing effects. In reporting on city and municipal problems in wartime, A. D. Butler described a bombing trial staged at the city water-pumping plant. He said that, within forty-five minutes, emergency telephones, lights, and sanitary facilities were erected, and provision was made for first aid. The final speaker was E. L. Haines, who had been assigned the topic of transportation.

Tennessee Valley Section

At the October meeting of the Chattanooga Sub-Section, W. H. Sears discussed the problems connected with the enforcement of engineers' registration laws. Mr. Sears has been a member of the Tennessee State Board of Architectural and Engineering Examiners since the first board was authorized. At a special luncheon meeting, called on November 6, James E. Jagger, new Field Secretary of the Society, conducted an informal discussion of the activities of the Society.

On October 14 members of the Knoxville Sub-Section heard C. B. Coe, lieutenant colonel, Corps of Engineers, U.S. Army, speak on the work of the army in the training of reserve officers. His talk was followed by a moving picture showing the combat vehicles of the mechanized cavalry and, also, the training of German parachute troops. The after-dinner entertainment consisted of a series of piano solos, played by Miss Hoyle Jenkins.

Tri-City Section

A joint dinner meeting of the Tri-City Section, the Rock Island County Reserve Officers Association, and local groups of the American Society of Mechanical Engineers and the Society of American Military Engineers took place in Moline, Ill., on October 20. The technical program consisted of a talk on the subject of "National Defense, Past, Present, and Future," which was given by Harry W. Hill, colonel, Corps of Engineers, U.S. Army. Colonel Hill stressed particularly the fallacy of the theory of no preparation for war during years of peace.

Wisconsin Section

The new engineering building on the Marquette University campus was inspected and discussed at a joint meeting of the Wisconsin Section and the Engineers' Society of Milwaukee, which was held on October 22. Father McCarthy expressed a desire to have the various engineering societies make the new building their regular meeting place. An overhead traveling crane, gift of a Milwaukee industrialist, was then displayed in action. The crane picked up a large table laden with dishes and food, carried it over the heads of the seated group, and placed it in the front of the room, after which the members filed past and served themselves to a buffet supper. Professor Shodron, of the Marquette engineering staff, then gave an illustrated talk on construction features of the new building. Many types of construction were used in the interests of economy and expediency, and parts of walls and ceilings have been left exposed so that students may readily study detailed features of the various methods.

Student Chapter Annual Reports

Abstracts of 1940–1941 Reports from the Eastern District as Provided by the Society's Committee on Student Chapters. Abstracts from the Southern, Western, and Northern Districts Appeared in the October and November Issues

Brown University

In order to raise money for the New England Regional Conference (reported in the June 1941 issue of Civil Engineering), the Brown Engineering Society (made up of the three Student Chapters of the Founder Societies) gave a dance, "The Hydraulic Jump." As decorations for the dance there were various models, including a model of a hydraulic jump in operation, especially constructed for the occasion by two of the senior civil engineers, a plate-girder bridge, and a riveted joint made of wood. The dance was pronounced a success by everyone who attended, or had any part in it whatever, and enough money was realized from the venture to insure the financial success of the conference.

Among the Chapter's activities for the year were two steak suppers held at the Brown University Outing Reservation, just outside of Providence. At the first supper, held on November 21, the entire engineering faculty and several invited guests prominent in the profession were present. Instead of having a formal speaker at an informal supper, the faculty and guests mingled with and talked to the students after the meal. In this way a much closer relationship between the boys and some of the men prominent in the profession was reached.

Columbia University

Many interesting and instructive meetings were enjoyed during the year. The members of the Chapter were able to trace the development of engineering from ancient times. At one meeting Dean Arnaud, of the School of Architecture, traced the development of architecture and engineering while, at another, Professor Dinsmoor of the archaeology department described the problems that faced the ancient Greeks in the building of their monumental structures. Then Prof. J. K. Finch, Faculty Adviser, tied these talks together by retracing the development of engineering texts from early days to modern times. Later Professor Finch spoke on the topic of suspension bridges, giving the audience a better background for understanding pictures of the Tacoma Bridge failure. This meeting proved to be the most popular of all.

The spring session saw a continuance of the historical note with a series of student papers that dealt with the construction of famous tunnels and the history of transportation in the United States.

Manhattan College

The second meeting in March inaugurated a series of symposia on problems of vital interest to national defense. These symposia were held under the joint sponsorship of the Manhattan College Student Chapter, the Manhattan College School of Engineering, and the Manhattan Engineering Defense Training School. The Student Chapter is very proud that it was able to take part in the preparation of such a program.

The first of these symposia dealt with the "Role of the Sanitary Engineer in National Defense." The Student Chapter took care of all the correspondence in connection with arranging the program, and the following speakers were scheduled: Arthur P. Miller, sanitary engineer for the U.S. Public Health Service; Anselmo Dappert, principal sanitary engineer of the New York State Board of Health; and Seth Hess, chief engineer of the Interstate Sanitation Commission and Metropolitan District Coordinator for Civilian Protection in Case of War. In addition a colored motion picture, showing several aspects of the stream pollution problem in the Ohio River, was shown through the courtesy of the U.S. Public Health Service.

At the second of the symposia the topic for panel discussion was "Power and the Defense Needs." The national defense needs were discussed by Leland Olds, chairman of the Federal Power Commission, while Gerald V. Cruise, executive secretary of the New York State Power Authority, talked on the power needs for state defense. The metropolitan defense needs were explained by C. Parker, vice-president of the Consolidated Edison Company.

In addition to these programs, the Chapter, in conjunction with the Manhattan Engineering School, sponsored a series of lectures on city planning.

Newark College of Engineering

"The following report is a summary of the activities of the Newark College of Engineering Student Chapter for the year 1940–1941. In it the secretary has tried to tell of the activities in which the members have participated. He has found it hard to show how much these activities have benefited the members, both professionally and socially.

"The Chapter had the good fortune to obtain excellent speakers at all its meetings. The speakers covered various civil engineering topics. No two were similar. The wide range of topics did much to interest the members in all branches of civil engineering. Refreshments after each meeting and the annual picnic helped the members to become acquainted and fraternize with members of different classes, faculty members, and speakers.

"Reports of meetings appeared in Civil Engineering, *Technician, Newark Engineering Notes*, and the *Newark Evening News*."

New York University

The activities of the New York University Student Chapter were started by the Day Group with a business meeting held early in the fall. There were 45 present, and all indicated a desire to join the Student Chapter. Faculty Adviser Douglas Trowbridge spoke on the advantages of membership in the Student Chapter and of the further advantages of membership in the Society after graduation. He enumerated the special advantages to those who

Some Members of the New York University Group at Tallman's Island Sewage-Treatment Plant

live in or near New York City and urged that no man try to play the part of a "lone wolf." He then suggested that each member consider himself a one-man membership committee to obtain as large a membership as possible. Finally, Professor Trowbridge outlined the requirements for a good secretary for the Student Chapter and asked that no man allow his name to be put in nomination unless he realized the work he would have to do and was perfectly willing to do it in a satisfactory and efficient manner.

Northeastern University

"Our first consideration before attempting to draw up any plan of events was that of deciding just what our Student Chapter should mean; what purpose it should serve; how it should fit into civil engineering training at Northeastern. It was our feeling that every organization should have some sound basis upon which to justify its existence. . . . Perhaps the best manner in which to show what the present officers have tried to accomplish is to introduce to you the Northeastern civil engineer and then explain how we have tried to fit our Chapter into this student's needs.

"The Northeastern civil engineer has many particular characteristics, some of which aid considerably in the formation and

functioning of a professional society while many others make the operation of such an association most difficult. In the first place, he is largely a commuter, and a very busy one at that. His program when at school (the cooperative work plan is used at Northeastern) is extremely heavy, keeping him in classrooms and laboratories until four or five o'clock each day.... During his working period, he may be employed in any of the Northeastern states, usually on construction and engineering projects. Unless he is located within a few miles of Boston, it is impossible for him to attend the Student Chapter's affairs.

"On the other hand, through his cooperative experience, he has developed a consciousness and appreciation of his profession. He has worked with real engineers and has engaged in genuine engineering work. He appears to be a bit older than the average college man, and has well-developed professional interests.

"Now, what we, the officers of the Student Chapter, have tried to do is give this student engineer a means of satisfying these interests and in so doing to round out his student training with a full appreciation of the aims and activities of the Society. We feel that we solved our attendance problem by holding the meetings evenings, following the completion of the school day. The meetings lasted usually from 6 to 9:30 p.m. and consisted in general of dinner, a business session, speaker, and discussion...."

Yale University

"The theme of the program for our Chapter during the past year was planning, and it was around this aspect of civil engineering that our activities were centered. Our definition of civil engineering is 'Planning for the use of land and for the control and use of water and designing and construction works necessary to carry out this plan.'"

The development of this theme was commenced early in the school year by the formation of a committee to prepare for the annual engineering exhibit. The purpose of the committee was to incorporate this aspect of planning into as many realistic phases of exhibits and demonstrations as would be possible in the coming exhibit. Modern transportation was studied, advancement in rural highway design was discussed, industrial plant layouts were considered, and the entire field of future planning was thoroughly covered by the committee. This comprehensive study of the objective provided an excellent background for the construction of a model which, in itself, was to be entirely typical of modern civil engineering planning, and which became the highlight of the civil engineering exhibit held in February.

The culmination of the committee's investigations, together with frequent discussions with the Faculty Adviser and other faculty members, resulted in the construction of a 10 by 20-ft model, shown in the accompanying photograph. The base was composed of closely packed sand, and the contours of an irregular landscape were genuinely effected. Roads were laid with a cement-plaster of Paris composition, as were the lengthy runways on the municipal airport. A realistic railroad ran through a tunnel and branched out into the shipping yard of an industrial plant. A reservoir, complete with dam and spillway over which water coursed, furnished an effective demonstration of hydraulic layout. Power lines, masonry and steel truss bridges, and a clover leaf were only a few of the features of the model that displayed foresight and efficiency in civil engineering planning.

"Another important aspect of the Student Chapter program was the establishing of a noticeably closer tie between students and faculty. This was evidenced by the numerous discussions between the faculty and Chapter members, the dinners, and the informal get-togethers. These activities strengthened faculty and student relationships which, we feel, is one of the outstanding accomplishments of the year."

Polytechnic Institute of Brooklyn

"This annual report closes the fourth successful year for the Evening Section of the Brooklyn Polytechnic Institute Student Chapter. The Evening Section was established as a separate group with its own officers, independent of the Day Section, after a combined group proved unsuccessful. It was impossible to arrange meeting dates suitable to the majority of both groups. With the help of the faculty and the permission of the Society, our Evening Section was organized, and has proved most beneficial in the advancement of a more professional attitude among the students.

"The existing emergency. . .has affected us both profitably and otherwise. The Army has taken many of our fellow students while still others have left town for defense work, thereby lowering our membership. On the other hand, a shortage of engineers has produced more interest in technical training thereby refilling our ranks, and many of us have obtained positions in the engineering field which were not available before the war.

"Our chief aim is to maintain at all times the high standards of the Society and to strive to develop a professional attitude."

University of New Hampshire

It was decided at the first Chapter meeting of the second semester to devote most of the time usually set aside for Chapter meetings to the construction of models and projects for the Open House, which was held in connection with the seventy-fifth anniversary celebration of the founding of the university. That this decision was a fortunate one is seen by the fact that many visitors ranked the civil engineering exhibits with the best on the campus. Some of the projects that took time as well as ability were a model of an old-fashioned water wheel and mill, a modern hydroelectric plant, a plaster model of a four-leaf clover intersection, and a deck-plate girder bridge. Not only did the actual construction of these models and projects prove interesting, but the work involved study and research.

Civil Engineering Model Displayed by Yale University Chapter at Annual Civil Engineering Exhibit

ITEMS OF INTEREST

About Engineers and Engineering

Civil Engineering for January

Life in a large construction camp is the subject of the paper by Mrs. David C. May, who lives in Shasta, Calif., where her husband is on the engineering staff of Pacific Constructors, Inc., engaged in building Shasta Dam. It is seldom that the wife of an engineer consents to give her viewpoint in print, and Civil Engineering is fortunate to have this unique account of life in camp as told by the wife of one of our members. This article is of timely interest because of the great number of engineers and their families now living in camps around our new defense projects.

Sixteenth century irrigation work in Mexico is described by Francisco Gomez-Perez, Chief of the Department of Statistics, Mexican Commission of Irrigation, in his paper to appear in the January issue. The early irrigation works, planned and executed by the Spanish missionaries, show advanced engineering and administrative ability.

The construction of the Washington National Airport, by dredging fill from the Potomac River and building up Gravelly Point, is described in a soil mechanics paper by B. K. Hough, Jr., Senior Engineer, U.S. Engineer Office, Binghamton, N.Y. These large-scale dredging operations required delicate correlation of settlement, drainage, and construction speed. They show in a striking manner how laboratory results must be interpreted in the light of practical experience.

Recent earthquakes in Southern California emphasize the value of the work described by N. H. Heck, Chief, Division of Terrestrial Magnetism, U.S. Coast and Geodetic Survey, in his paper on "Advances in Engineering Seismology." Methods of seismological research are described by Mr. Heck in this condensed version of a report prepared in connection with the work of the Society's Joint Committee on Seismology.

In addition, there will be other papers on a variety of subjects, including several from Society meetings.

Neches River Bridge on Page of Special Interest

The recently completed vertical-lift bridge shown on the Page of Special Interest in this issue, is on the Kansas City Southern Railroad over the Neches River near Beaumont, Tex., and has a span of 245 ft. The bridge towers are 199 ft above the pier level, and the span rises 131.6 ft in less than three minutes. There is a clearance of 153 ft above average water level. The engineers in charge of design were Howard, Needles, Tammen and Bergendoff, of Kansas City, Mo., and New York.

An American Hydrologist in China

As noted in a previous issue, Past-President Mead was honored with a scroll, at the recent hydrology conference held at Pennsylvania State College, in recognition of his work in the field of hydrology and hydraulic engineering. The following excerpts from Dr. Mead's interesting speech of acceptance will be of interest.

In 1914 I accepted an invitation to become one of a commission appointed by President Wilson—on the nomination of Colonel Sibert, chairman—to go to China on behalf of the American Red Cross and the new Chinese Republic to determine the feasibility of plans for the flood protection of the Huai River valley.

"This Chinese trip was of great interest. For centuries the Huai River valley had been subject to extensive flood losses of both life and property. If the people escaped death from drowning, they very likely starved to death from the resulting famine. . . . History tells us that four thousand years ago . . . Ku, the first hydraulic engineer on record, was appointed to rescue the Chinese people from such catastrophes. Ku evidently placed his faith in dikes, and worked on a dike project seven years, at the end of which period an unusually large flood destroyed the dikes and Ku was beheaded. This was rather a severe reprimand, but one which was sure to prevent further mistakes on the part of Ku. While I would not advise the adoption of such a rule in this country, I am impressed with the great improvement in engineering work that such a rule would assure.

"Following this tragic event, Yu, son of Ku, was appointed to accomplish the ends which his father failed to secure. 'Yu dredged the channels of the nine streams; opened the Tsi and Lou, closed the Nu and Hun, separated the Huai and Sze, and drained them all into the sea.' Yu's work was a success, and he was made emperor and denominated 'The Great Yu.' In every city in China there is a temple dedicated to him. This is another idea as to the encouragment of good engineering work in this country. . . .

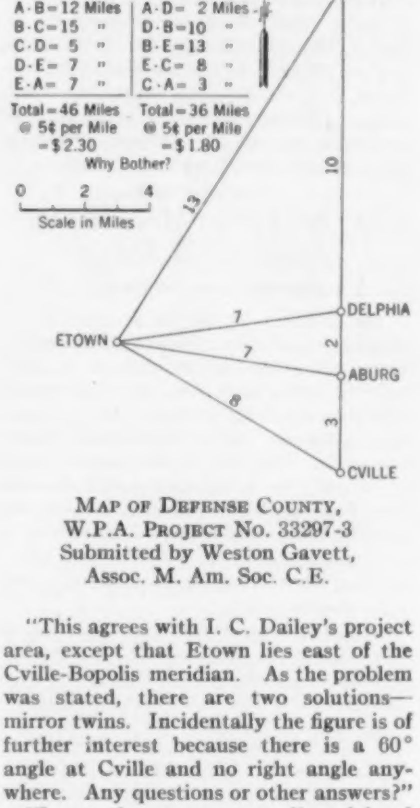
"In China the principles of hydraulics and hydrology seem to be (at least in the minds of the Chinese people) somewhat different from ours. It seems that certain dragons are active in certain unfortunate ways and have to be carefully watched. While our commission was some 600 miles in the interior of China, an eclipse of the moon occurred. I inquired through our interpreter of a Chinese soldier—who was on guard on the back platform of our private car—what was happening to the moon, and he replied with a grin that something was eating it. When an eclipse occurs in China the people get out with gongs, firecrackers, and various other noisy equipment, to drive the dragon away from its intended victim. I can certify that such efforts are effective, for in the course of a few minutes the moon emerged from its trouble and sailed majestically and serenely away for the remainder of the night. We learned, also, that the frequent floods in China are caused by dragons which dig into the mountains and release the flood waters. I was only in the foothills and saw no evidence of this. We, of course, regard these ideas as superstitious for we of this enlightened country know that floods are caused by deforestation! We in America, as well as the Chinese people, are more or less human and hence possibly fallible."

Prof. N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

"Because of annual reports to follow, we must be brief tonite," opened Professor Neare. "So I call your attention to this map which has been submitted in answer to the October problem.



Map of Defense County,
W.P.A. Project No. 33297-3
Submitted by Weston Gavett,
Assoc. M. Am. Soc. C.E.

"This agrees with I. C. Dailey's project area, except that Etown lies east of the Cville-Bopolis meridian. As the problem was stated, there are two solutions—mirror twins. Incidentally the figure is of further interest because there is a 60° angle at Cville and no right angle anywhere. Any questions or other answers?"

"I got the same answer," exclaimed Cal Klater, "but I had to use pins and concentric-circle-templates instead of algebra. Is there a solution by rigid analysis?"

"Not that I know of. The data can be reduced to 5 equations in 6 unknowns plus

4 integral requirements, which no one succeeded in solving. However it can be deduced quickly that the distance from Bopolis to Delphia must be 10, 11, 12, 13, 14, 15, or 16. Trying each in turn as a sixth equation will give 7 sets of solutions. Luckily the first trial (10) will be the right one, for all others fail to meet the integral conditions.

"Former Guest Professor Richard Jenney is here again tonite and says he has a problem that will give you more trouble than your Xmas shopping or that Hollywood bathroom. Tell away, Dick."

"My problem is a sequel to your September puzzle of the captured and escaped Slavs," said Jenney. "After Igor Runnenoff, the red-headed leader, joined his 709,639,444,800 comrades, they returned to the battlefield and found their discarded and scattered helmets and rifles. Each grabbed one helmet and one rifle at random.

"Said Igor, 'I'll lay my last ruble to 16 kopecs that one of us gets either his own helmet or his own rifle.'

"'Taken, by goshzki!' yelled Ivan Uffoff. 'Surely, Comrade, you meant your last kopec against 16 rubles, or as many chervonetzen!'

"Was the bet fair and/or what were the odds?"

"And may I add," concluded the Professor, "that those who dislike large numbers may have as much fun computing the odds if there had been only 7 or 8 Slavs."

(First ten correct solvers of the October problem were: Richard Jenney, C. O. Baker, Weston Gavett, D. E. Hughes, J. C. F. Shafer, A. Nuther Nutt (of Pittsburgh), F. C. Prescott, Alfred Africano, Roland Vokac and J. C. Harker—all members except Mr. Vokac, Professor Prescott and, for all we know, Nutt.)

A. N. Talbot Honored by American Railway Engineering Association

ON OCTOBER 21 the American Railway Engineering Association unveiled a tablet citing the achievements of A. N. Talbot, Past-President and Honorary Member of the Society, as chairman of the A.R.E.A. Committee on Stresses in Railroad Track. From the inception of the committee in 1914 until his resignation a few months ago, Professor Talbot was in charge of the investigation of this committee, which is said to constitute the best body of information about stresses in railroad track available anywhere.

The unveiling ceremonies took place in the College of Engineering of the University of Illinois, to which the tablet was presented in tribute to Professor Talbot's long career as engineering teacher there (he retired in 1926 with the title of professor emeritus). Dean M. L. Enger accepted the tablet for the university, and F. L. C. Bond, president of the A.R.E.A., delivered the principal address. The response by Professor Talbot closed the exercises. The tablet will be placed in the Arthur Newell Talbot Laboratory of Materials Testing.

Mathematical Tables Available

AN activity of the Works Projects Administration that deserves to be noted by engineers is the compilation and publication of useful mathematical tables. Among those completed, the following are of potential interest to civil engineers:

1. Table of the First Ten Powers of the Integers from 1 to 1,000. 80 pp. (1939).

2. Tables of the Exponential Function e^x. 535 pp. (1939).
   $x = [-2.5000(0.0001)1.0000;\ 18D]$,
   $x = [2.500(0.001)5.000;\ 15D]$,
   $x = [1.0000(0.0001)2.5000;\ 15D]$,
   $x = [5.00(0.01)10.00;\ 12D]$.

3. Tables of sin x and cos x for Radian Arguments. 275 pp. (1940).
   $x = [0.000(0.001)25.000;\ 8D]$,
   $x = [0.00001(0.00001)0.00009;\ 15D]$,
   $x = [0.001(0.001)0.009;\ 15D]$,
   $x = [0.1(0.1)0.9;\ 15D]$,
   $x = [0(1)100;\ 8D]$,
   $x = [0.0001(0.0001)0.0009;\ 15D]$,
   $x = [0.01(0.01)0.09;\ 15D]$,
   $x = [0.00000(0.00001)0.01000;\ 12D]$.
   There is also included a conversion table between radians and degrees.

4. Tables of sin x, cos x, sinh x, cosh x for Radian Arguments. 405 pp. (1940).
   $x = [0.0000(0.0001)1.9999;\ 9D]$,
   $x = [0.0(0.1)10.0;\ 9D]$.
   There is also included a conversion table between radians and degrees.

5. Tables of Planck's Radiation and Photon Functions. Published in the Journal of the Optical Society of America, vol. 30, pp. 70–81 (1940).

6. Tables of Grid Coordinates (American Polyconic Projection) at 5-min intervals of latitude and longitude for latitudes from 7° to 28°. (For the War Department.)

7. Tables of Grid Coordinates of Northwestern Extension of U.S. (American Polyconic Projection. For the War Department.)

8. Table for Map Projections of Northwestern Extension of U.S. (American Polyconic Projection. For the War Department.)

These can be secured by writing to the Federal Works Agency, Works Progress Administration, 70 Columbus Avenue, New York, N.Y.

In addition to those listed, other tables are being prepared.

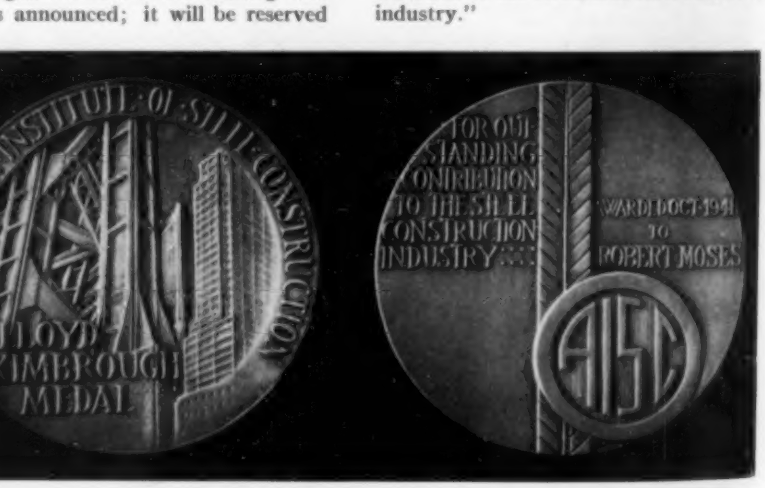
The J. Lloyd Kimbrough Medal—First Award to Robert Moses

A NEW AWARD has been established by the American Institute of Steel Construction—the J. Lloyd Kimbrough Medal. The purpose is to "commemorate achievements in steel construction," and also to honor one of the founders and the first president of the Institute, J. Lloyd Kimbrough. He held that office for seven years and thereafter was a board member until his death a few years ago. His business connection was with the Indiana Bridge Company of Muncie, Ind.

The medal, of solid gold, is symbolic in design. It may be awarded for accomplishments in the engineering or public service fields, providing the recipient has an outstanding record in promoting the usefulness of structural steel.

No regular interval for making this award is announced; it will be reserved for proper occasions whenever they occur. The first recipient has a notable career to his credit. He is the Hon. Robert Moses, Commissioner of Parks of New York City, as well as president of the Long Island State Park Commission, and holder of other offices in parkway and bridge work. Well known among public officials and engineers alike are his achievements in creating over a half-billion dollars worth of improvements in and about New York City. These have included state and city parkways, bridges, parks, and beaches.

For these accomplishments, in which he is still engaged, the first award of the medal was made at the annual meeting of the Institute in White Sulphur Springs, on Thursday, October 16. No engineer will deny that Mr. Moses well satisfies the requirements for such a medallist, a "man who has made an outstanding contribution to the structural steel fabricated industry."



J. LLOYD KIMBROUGH MEDAL

Research Fellowship Available at Lehigh University

AN AMERICAN Institute of Steel Construction research fellowship is available at Lehigh University, starting in either February or September 1942 and continuing for a two-year period. The annual salary is $750 for ten months of half-time research work, together with freedom from tuition fees, the holder of the fellowship to have the privilege of carrying on part-time graduate study toward an M.S. or Ph.D. degree. Problems in the modern design of steel structures will be investigated analytically and by structural test.

Applicants must have a bachelor's degree in civil engineering, and each should submit a transcript of his scholastic record, a list of references, and a statement regarding any special qualifications. Applications should be forwarded to Dr. Bruce G. Johnston, Lehigh University, Bethlehem, Pa.

D. Robert Yarnall Awarded Hoover Medal

ANNOUNCEMENT has been made of the selection of D. Robert Yarnall, mechanical engineer of Philadelphia, Pa., as the fifth recipient of the Hoover Medal. The medal will be presented to Mr. Yarnall on December 3, during the annual meeting of the American Society of Mechanical Engineers, with the following citation: "D. Robert Yarnall, humanitarian, engineer, and a leader in the engineering profession, who rendered outstanding service as a member of a mission that fed the children of Germany at the end of the World War and that is now aiding refugees in this country and Europe and providing food and relief for the children and mothers of France. These distinguished public services have earned for him the Hoover Medal for 1941."

Engineering service with several Philadelphia firms engaged Mr. Yarnall's earliest efforts. Later—from 1912 to 1918—he was vice-president and general manager of the Nelson Valve Company. Since 1912, also, he has been continuously identified with the Philadelphia firm of Yarnall-Waring Company, of which he was a co-founder. He now holds the office of vice-president and chief engineer and is, also, a director and vice-president of the James G. Biddle Company and the Pullenlite Company, both of Philadelphia. He served as a member of the Board of the Engineering Foundation from 1928 to 1937, and is a Fellow of the American Society of Mechanical Engineers.

The Hoover Medal was established in 1930, during the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers, to commemorate the civic and humanitarian achievements of former President Herbert Hoover, Hon. M. Am. Soc. C.E., to whom the first award was made. The other recipients were Ambrose Swasey and John F. Stevens, Honorary Members Am. Soc. C.E., and Gano Dunn, M. Am. Soc. C.E.

NEWS OF ENGINEERS

Personal Items About Society Members

ADDITIONAL members of the Society in the U.S. Naval Reserve who have been called to active duty include Lt. Comdr. Lloyd G. Frost, from general superintendent for the Louisiana Geodetic Survey, of New Orelans, La., to the Fourteenth Naval District at Pearl Harbor, T.H.; Lt. Comdr. Paul F. Keim, from hydroelectric engineer for the Federal Power Commission, Washington, D.C., to resident engineer officer in charge of construction at the Midway Islands outpost, Midway Islands, U.S.A.; and Lt. Comdr. Charles L. Pool, from chief engineer for the Rhode Island State Department of Public Health at Providence, R.I., to the Naval Operating Base at Norfolk, Va.

Lt. Floyd L. Bollen, from associate engineer for the PWA, Nebraska Hydroelectric Projects at Kearney, Nebr., to the Naval Operating Base at Norfolk; Lt. Henry W. Bressler, from engineer for the U.S. Housing Authority at Silver Spring, Md., to the Bureau of Yards and Docks, Washington; Lt. John D. Burky, from assistant engineer for the U.S. Bureau of Reclamation at Boise, Idaho, to the Fourth Naval District at Philadelphia, Pa.; Lt. James G. Crooks, from construction engineer for the Bethlehem Steel Company at Cleveland, Ohio, to the Bureau of Yards and Docks, Washington; Lt. Glenn L. Enke, from associate engineer for the California State Division of Highways to the Bureau of Yards and Docks; Lt. Thomas E. Ferneau, from resident engineer for the California State Division of Highways at San Francisco, Calif., to the Naval Operating Base at Norfolk; Lt. Raymond E. Flint, from field and office engineer for the Frazier-Davis Construction Company at Mahopac, N.Y., to the Naval Operating Base at Guantanamo Bay, Cuba; Lt. Edward H. Gessner, from civil engineer of New Orleans, La., to the Naval Air Station at Alameda, Calif.; Lt. Henry F. Hormann, from assistant division engineer for the Consolidated Edison Company of New York, Inc., to the Bureau of Yards and Docks in Washington; Lt. William S. LaLonde, Jr., from professor of civil engineering at Newark College of Engineering, Newark, N.J., to the New York Navy Yard at Brooklyn, N.Y.; Lt. Robert B. Morris, from associate engineer for the U.S. War Department in Washington, D.C., to the Naval Station at Key West, Fla.; Lt. William W. Studdert, from civil engineer for the Texas-New Mexico Pipe Line Company at Midland, Tex., to the Naval Operating Base at Norfolk, Va.; Lt. R. D. Thorson, from associate bridge engineer for the California State Division of Highways at Los Angeles, Calif., to the office of the Supervisor of Shipbuilding, Los Angeles Shipbuilding and Dry Dock Company, San Pedro, Calif.; Lt. William K. Van Zandt, from distribution engineer for the Houston (Tex.) Water Works, to the Navy Yard at Philadelphia, Pa.; and Lt. Gustave G. Werner, Jr., from field engineer for Malcolm Pirnie, of New York, N.Y., to the Bureau of Yards and Docks, Washington.

Ensign William W. Olmstead, from inspection engineer for the Atlantic Mutual Insurance Company, New York, N.Y., to the Fourth Naval District, Philadelphia, Pa.; and Ensign Richard L. Steiner, from assistant project planner for the U.S. Housing Administration, Washington, D.C., to the Naval Air Station at Jacksonville, Fla.

JOHN W. B. BLACKMAN announces that he is opening offices in the Foreman Building in Los Angeles, Calif., and that he will also assume the private practice of COMDR. GEORGE F. NICHOLSON who has been called to active duty with the 11th Naval District at San Diego, Calif. For the past year Mr. Blackman has been employed as construction engineer on the building of various facilities for the 11th Naval District.

JOHN L. NAGLE, until lately head engineer of the Eastern Division, Corps of Engineers, U.S. Army, Washington, D.C., is now chief of the engineering section of the Caribbean Division, with headquarters in New York, N.Y.

ARTHUR B. MORRILL has been granted a year's leave of absence from his position as engineer of sewage treatment for the Detroit (Mich.) Department of Water Supply in order to serve as senior sanitary engineer for the medical commission being sent to China by the U.S. Public Health Service. The commission will be engaged in the control of malaria and on other health problems arising in connection with the construction of the Burma-Yunnan Railroad.

ROBERT O. R. MARTIN, who is on the staff of the Water Resources Branch of the U.S. Geological Survey, has been designated associate hydraulic engineer in charge of the St. Louis (Mo.) office of the Survey, a coordinating office for Mississippi River records. Mr. Martin was formerly in the Albany (N.Y.) office of the Survey.

ELLIOTT J. DENT, colonel, U.S. Army, retired, who for the past year has been on active duty in the Office of the Chief of Engineers as senior member and executive of the Beach Erosion and Shore Protection Boards, has returned to the retired list and resumed his practice at 3403 Rodman Street, N.W., Washington, D.C., where he will be available for consultation.

MASON C. PRICHARD is now chief of operations of the Caribbean Division of the Corps of Engineers, U.S. Army, with headquarters in New York City. He was formerly in charge of the Flood Control Section in the Office of the Chief of Engineers, Washington, D.C.

WILLIAM H. HALL, recently resigned as assistant city engineer of Oklahoma City, Okla., to accept a teaching position in the civil engineering department of Oklahoma Agricultural and Mechanical College at Stillwater.

FLETCHER W. PEARCE, formerly assistant professor of mathematics at the New Mexico School of Mines, is now associate

professor of civil engineering at North Carolina State College.

E. C. DeGarmo has been promoted from the position of division engineer for the Florida State Highway Department to that of assistant state highway engineer.

Charles E. Davis is now city engineer of Spokane, Wash., succeeding the late A. D. Butler. He was formerly assistant city engineer.

Lewis B. Moore has been appointed assistant chief quartermaster in the supply department of the Canal Zone, with headquarters at Balboa Heights, C.Z. He was previously office engineer for the Canal Zone.

George Kumpe, captain, Corps of Engineers, U.S. Army, has been ordered transferred from Cincinnati, Ohio, to Cleveland, where he will be assistant to the U.S. Division Engineer in charge of the Great Lakes Division.

Newlin D. Morgan, Jr., recently resigned as structural designer in the bridge office of the New Mexico State Highway Department at Santa Fe, N.Mex., in order to accept a position as instructor in the civil engineering department at Rutgers University.

John Sweeney, until lately superintendent of the Board of Public Utilities of Paris, Tenn., has gone to Trinidad, B.W.I., to act as operation manager on air-base construction.

James L. Land has been granted a leave of absence as materials engineer for the Alabama State Highway Department in order to serve as principal engineer, Airport Division of the U.S. Engineer Office in Washington, D.C.

Ben E. Torpen has been appointed chief of the general engineering division of the Portland (Ore.) District of the U.S. Corps of Engineers, succeeding Maj. Paul D. Berrigan, who has been transferred to Dallas, Tex. Mr. Torpen, for the past two years assistant to Major Berrigan, will direct all flood control work and military construction projects in the Portland District.

Walter H. Norris announces his retirement as structural engineer for the Maine Central Railroad after fifty years of service with this line and the Boston and Maine. He is taking up residence at 24 Glenwood Avenue, Portland, Me.

Harry M. House is now chief engineer for Dunning-James-Patterson, general contractors of Oklahoma City, Okla.

Orville V. Derr has temporarily closed his private office at 122 East 42d Street, New York City, in order to become associated with Dry Dock Associates as assistant superintendent and chief engineer on the construction of the St. Helena Destroyer Base at the Norfolk (Va.) Navy Yard.

Stanley T. Barker, lieutenant commander, Civil Engineer Corps, U.S. Naval Reserve, is now on duty in the Aviation Facilities Division of the Bureau of Yards and Docks, Washington, D.C.

DECEASED

Charles Newton Bainbridge (Assoc. M. '17) project engineer for the PWA in Chicago, Ill., died on July 1, 1941. Mr. Bainbridge was for a number of years engineer of design for the Chicago, Milwaukee and St. Paul Railway, with headquarters in Chicago. He became project engineer for the PWA in 1938.

William Israel Bishop (M. '06) construction engineer of Montreal, Canada, and a member of the Montreal Tramways Commission, died at Joliette, Quebec, on October 2, 1941. He was 66. In 1919 Mr. Bishop became managing director of the Raymond Concrete Pile Company in Montreal and the following year founded his own company under the name of William I. Bishop, Ltd.

Joseph Bourguignon (Assoc. M. '10) consulting engineer of Flushing, N.Y., died in that city on October 17, 1941. Mr. Bourguignon, who was 62, had been with the American Bridge Company, Milliken Brothers, Post and McCord, and several other engineering firms.

Robert Francis Brown (M. '30) plant manager of the California Water Service Company, died on October 29, 1941. He was 45. From 1916 to 1925—except for a period of war service—Mr. Brown was with the Burns and McDonnell Engineering Company, of Kansas City, Mo. Later he was with the Western Pipe and Steel Company and the Public Works Engineering Corporation, San Francisco. During the war he served with the 110th Engineers, 35th Division, of the U.S. Army.

Walter Edward Dauchy (M. '03) of Riverside, Calif., died at his home there on October 23, 1941, at the age of 86. During his earlier years Mr. Dauchy was engaged in railroad construction work in the West. From 1899 to 1903 he served as chief engineer of the Chicago, Rock Island and Pacific Railway, and from 1904 to 1906 as division engineer on the Culebra Division of the Panama Canal. He then spent three years in charge of construction for the Chicago, Milwaukee and Puget Sound Railroad on its Pacific Coast extension between Butte, Mont., and Avery, Idaho. He retired in 1910.

George Christian Graeter (Assoc. M. '17) since 1931 vice-president and general manager of the Richmond Sand and Gravel Corporation, of Richmond, Va., died in February 1941, though the Society has just heard of his death. He was 53. Mr. Graeter was in the U.S. Engineer Department from 1905 to 1913, and development and chief engineer of the Western Tie and Timber Company, of St. Louis, Mo., from 1919 to 1926. During the war he served as a captain with the A.E.F. in France in charge of the location and construction of military railroads.

Charles Samuel Green (M. '12) consulting engineer of New York, N.Y., died on October 23, 1941. Mr. Green, who was 68, was engineer of design for the Borough of the Bronx from 1912 to 1917, and from 1919 to 1921. From the latter year to 1936 he was, successively, manager, construction engineer, and president of the Klein and Jackson Construction Company, of New York City. He then established his consulting practice. During the war he served in the Engineer Corps of the U.S. Army, with the rank of captain.

Charles Howard Paul (M. '08) consulting engineer of Dayton, Ohio, died on October 6, 1941. He was 66. Mr. Paul was with the U.S. Bureau of Reclamation

Charles H. Paul

from 1904 to 1915, and from the latter year to 1924 was with the Miami Conservancy District—part of the time as chief engineer on the construction of its five dams. From 1916 on, he also maintained a consulting practice. Some of the large projects on which he was engaged as a consultant were Grand Coulee Dam, the Central Valley Project, and the TVA dams. He was an original member of the Dayton City Planning Board, resigning to assume duties with the Dayton City Commission. Long active in the affairs of the Society, Mr. Paul served as Director from 1924 to 1928. In 1922 he was the recipient of the Society's Norman Medal.

Hermann Meriwether Knapp (M. '05) retired engineer of Covington, Ky., died at his home there on October 17, 1941. Mr. Knapp, who was 71, was for thirty-five years contracting manager of the American Bridge Company. At one time, also, he was connected with the U.S. Steel Company. He retired in 1936.

Edwin Weed Kramer (M. '25) regional director of the Federal Power Commission, San Francisco, Calif., died on October 31, 1941, at the age of 54. From 1907 to 1936 Mr. Kramer was an engineer in the U.S. Forest Service, and from the latter year on was in the San Francisco office of the Federal Power Commission. He was author and co-author of several works on hydraulics.

Engelbert Conrad Lawrence (Assoc. M. '09) civil engineer of Baltimore, Md., died at Catonsville, Md., on October 25, 1941, at the age of 66. For the past thirty years Mr. Lawrence had been connected with the U.S. Fidelity and Guaranty Company, and, at the time of his death, was contracting adjusting engineer. Earlier in his career he was assistant harbor engineer of Baltimore.

Henry Darcy Scudder (Assoc. M. '17) architect and engineer of Newark, N.J., died on October 4, 1941, at the age of 57. From 1901 to 1908 Mr. Scudder was in the office of W. P. Field, civil engineer of Jersey City, N.J. From the latter year on, he was in private practice in Newark, advising on numerous construction projects in the state of New Jersey.

Burr Henry Simpson (M. '28) until lately State Road Commissioner of West Virginia, Charleston, W.Va., died there recently. Mr. Simpson, who was 56, had been resident engineer for the Ohio State Highway Department (1914 to 1917); field engineer and assistant district engineer for the Portland Cement Association (1917 to 1921); and sales engineer for the Kentucky Rock Asphalt Company (1921 to 1927). From 1927 to 1934 he was city engineer of Buckhannon, W.Va.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From October 10 to November 9, 1941, Inclusive

Additions to Membership

Abrams, Michael Melvin (Jun. '41), Junior Naval Archt., U.S.N., Navy Yard, Philadelphia, Pa. (Res., 959 Fiftieth St., Brooklyn, N.Y.)

Abbott, Lyle Arnold (Jun. '41), Box 264, Pleasanton, Calif.

Adams, Sharold Everett (Jun. '41), Student Engr. (Civ.), War Dept., Caddoa (Res., 661 Moore St., Las Animas), Colo.

Adkins, Marvin Cecil (Jun. '41), Care, Special Eng. Div., The Panama Canal, Drawer B, Gatun, Canal Zone.

Alford, Wilson Merriman (Jun. '41), Junior Cartographic Engr., U.S. Coast and Geodetic Survey, Room 1009, Commerce Bldg. (Res. 428 Whittier St.), Washington, D.C.

Amster, Alvin Albert (Jun. '41), Junior Engr. (Civ.), U.S. Engr. Dept., 751 South Figueroa St. (Res., 1809½ South Sycamore Ave.), Los Angeles, Calif.

Andros, Carl (Jun. '41), Ensign, U.S.N.R., Fort Schuyler, New York, N.Y.

Apple, Donald William (Jun. '41), Care, Company B, 16th Engr. Battalion, U.S. Army, Fort Knox, Ky.

Baldinger, Edward Joseph (Jun. '41), Field Engr., Giffels & Vallet, Inc., and Charles W. Cole & Sons, Kingsbury Ordnance Plant, Kingsbury (Res., 406 Roosevelt Rd., Walkerton), Ind.

Bales, Byron William (Jun. '41), 2628 Chestnut, Kansas City, Mo.

Ballenger, Carl Benton (Jun. '41), 2d Lt., 8th Signal Company, U.S. Army, Army Post Office 8, Fort Jackson, S.C.

Belik, Charles Narcis, Jr. (Jun. '41), With Worden-Allen Co., 3d and Capital (Res., 5730 North Bay Ridge Ave.), Milwaukee, Wis.

Bills, William Francis (Jun. '41), 2d Lt., 41st Engrs. (Gen. Service), U.S. Army, Fort Bragg, N.C.

Birt, William Moler (Jun. '41), Structural Engr., Bureau of Yards and Docks, U.S.N., 18th and Constitution Ave. (Res., 1822 Kilbourne Pl.), Washington, D.C.

Blake, Robert Logan (Jun. '41), Junior Engr., U.S. Geological Survey, 402 Home Builders Bldg., Phoenix, Ariz.

Bobay, Paul (Jun. '41), 180 Riverdale Ave., Yonkers, N.Y.

Boise, Otis Wells (Jun. '41), Hurley, N.Mex.

Bolton, George Neilson (Jun. '41), Ensign, U.S.N.R., Office, Insp. of Navy Material, 600 Bryant St., San Francisco (Res., 2401 Warring St., Berkeley), Calif.

Bond, Charles Forrest (Jun. '41), Junior Civ. Engr., SCS, U.S. Dept. of Agriculture, San Fernando (Res., 1248 West 51st Pl., Los Angeles), Calif.

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Members	5,731
Associate Members	6,731
Corporate Members	12,462
Honorary Members	37
Juniors	4,650
Affiliates	68
Fellows	1
Total	17,218

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Zoller, James Harold (Jun. '41), 505 East Seneca St., Ithaca, N.Y.

Membership Transfers

Barrows, Daniel Joseph (Jun. '30; Assoc. M. '41), Civ. Engr., Spencer, White & Prentis, Inc., 10 East 40th St., New York, N.Y. (Res., 6030 Waterman Blvd., St. Louis, Mo.)

Bauknight, Wilfred (Jun. '33; Assoc. M. '41), Associate Engr., U.S. Engr. Dept., 1032 New Federal Bldg. (Res., 302 Aidyl Ave.), Pittsburgh, Pa.

Blount, George Cochran (Jun. '34; Assoc. M. '41), Civ. Engr., The Dur-ite Co., Box 215, Williams, Ariz.

Carter, George Richmond (Jun. '33; Assoc. M. '40), 340 Rosedale Ave., St. Louis, Mo.

Cavendish, Lynn Ray (Assoc. M. '36; M. '41), Dist. Engr., State Road Comm., 11 Day and Night Bldg. (Res., 1120 Oakmont Rd.), Charleston, W.Va.

Crowe, George Frederick (Jun. '33; Assoc. M. '41), Engr., Chg. of Design Section, U.S. Engr. Office, 415 Post Office and Courthouse (Res., 2801 Colonial Ave., Apt. 2), Norfolk, Va.

Dames, Trent Raysbrook (Jun. '34; Assoc. M. '41), (Dames & Moore), 816 West 5th St., Los Angeles (Res., 1965 El Molino Ave., San Marino), Calif.

Dunlop, John Arlington (Jun. '37; Assoc. M. '41), Asst. Prof. of Geodesy and Transportation Eng., Rensselaer Polytechnic Inst. (Res., 93 Twenty-third St.), Troy, N.Y.

Evernham, Earle Barnett (Jun. '33; Assoc. M. '41), Constr. Engr., The H. K. Ferguson Co., Box 709, Princeton (Res., 512 Wildwood Rd., West Allenhurst), N.J.

Green, Carl Edwin (Jun. '28; Assoc. M. '35; M. '41), 7441 South East 28th Ave., Portland, Ore.

Howe, Harry Northrop (Jun. '04; Assoc. M. '10; M. '41), Structural Engr. (Gardner & Howe), 76 Porter Bldg., Memphis, Tenn.

Kuan, Fu Chuan (Jun. '31; Assoc. M. '35; M. '41), House 6, Lane 607, Seymour Rd., Shanghai, China.

Langsner, George (Jun. '31; Assoc. M. '41), Asst. Dist. Constr. Engr., State Div. of Highways, 808 California State Bldg., Los Angeles (Res., 101 Pamela Rd., Arcadia), Calif.

Marr, John Gentle (Jun. '28; Assoc. M. '31; M. '41), City Planning Engr., City Planning Comm., 318 City Hall (Res., 4272 Lakeshore Ave.), Oakland, Calif.

Matzke, Arthur Edward (Jun. '30; Assoc. M. '41), Head, Men's Residence Halls and Associate in Civ. Eng., 101 Livingston Hall, Columbia Univ., New York, N.Y.

Nash, Charles Woods (Jun. '24; Assoc. M. '29; M. '41), Lt. Comdr., CEC, U.S.N.R., 13th Naval Dist., Exchange Bldg., Seattle, Wash.

Riggs, Henry Earle (Assoc. M. '93; M. '96; Hon. M. '41), Honorary Prof., Civ. Eng., Univ. of Michigan, Room 203, West Eng. Bldg., Ann Arbor, Mich.

Spath, Paul Christian (Jun. '35; Assoc. M. '41), Associate Hydr. Engr., TVA, 448 New Post Office, Chattanooga, Tenn.

Stoddard, Howard Augustus (Jun. '39; Assoc. M. '41), Asst. Engr., U.S. Bureau of Reclamation, 936 Eleventh St. (Res., 325 North Santa Ana Ave.), Modesto, Calif.

Strange, Orman Morton (Assoc. M. '37; M. '41), 3901 Meade St., Denver, Colo.

Sulkowski, Walter Valentine (Jun. '33; Assoc. M. '41), Asst. Structural Engr., TVA, 715 Union Bldg. (Res., 1408 Edgewood Ave.), Knoxville, Tenn.

Wetzler, Thomas Edward (Assoc. M. '25; M. '41), 106 Prospect Rd., Peoria, Ill.

Whitehead, William James (Jun. '36; Assoc. M. '41), With Constr. Div., War Dept., Office of Quartermaster Gen., Railroad Retirement Bldg., Washington, D.C. (Res., 328 North Piedmont St., Arlington, Va.)

Reinstatements

Bayliss, Paul M., reinstated Oct. 15, 1941.

Erskine, Alexander Madison, Assoc. M., reinstated Oct. 17, 1941.

Halloran, Edwin Francis, Assoc. M., reinstated Oct. 25, 1941.

Stevenson, DeWitt Alexander, Jun., reinstated Oct. 14, 1941.

Van Amburgh, Thomas Albert, Assoc. M., reinstated Oct. 17, 1941.

Resignations

Haines, William Lawrence Ross, M., resigned Oct. 17, 1941.

Varney, Edward Allen, Assoc. M., resigned Nov. 6, 1941.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

December 1, 1941 NUMBER 12

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

ANSCHUETZ, OTTO WILLIAM JULIUS (Assoc. M.), Kansas City, Mo. (Age 53) (Claims RCA 10.5 RCM 21.0) Feb. 1936 to date Res. Engr. and at present Chf. Engr., Kansas City (Mo.) Bridge Co.

BROWN, MARVIN SANGER (Assoc. M.), Cleveland Heights, Ohio. (Age 41) (Claims RCA 1.7 RCM 8.2) Sept. 1940 to date Sec. Head Draftsman, American Steel & Wire Co., Cleveland; previously Owner's Representative, MacGregor Home for Aged; Secy., Asst. Engr., and Vice-Pres., Wendell P. Brown Co.; with Firestone Tire & Rubber Co., Akron, Ohio; etc.

FILBY, ELLSWORTH LINCOLN (Assoc. M.), Kansas City, Mo. (Age 45) (Claims RCA 15.4 RCM 8.0) Aug. 1931 to date Prin. Asst. Engr., Black & Veatch.

FLINN, EVERETT BARNES, St. Louis, Mo. (Age 49) (Claims RCA 1.1 RCM 10.0) Aug. 1935 to date with WPA as Engr. of Constr. and Area Engr.

GARDNER, FRANK HENRY (Assoc. M.), Bridgeport, Ala. (Age 44) (Claims RCA 6.4 RCM 15.9) June 1941 to date Engr. (Civ.), U.S. War Dept., Corps of Engrs.; April to June 1941 Superv. Field Engr., R. L. Kenan & Associates, Cons. Engrs., Montgomery, Ala.; previously Staff Engr., WPA, Alabama; Res. Engr., Wilberding & Palmer, Cons. Engrs., Mobile; with FEA of PW as Associate Civ. Engr.; Locating Engr., Georgia Highway Dept., Atlanta; with TVA, Knoxville, Tenn., as Engr. Inspector.

GODDARD, JAMES ELMER (Assoc. M.), Washington, D.C. (Age 35) (Claims RCA 1.5 RCM 8.5) Jan. 1941 to date Capt., Corps of Engrs., U.S. Army, at present assigned to Engr. Reproduction Plant, Army War Coll.; previously with TVA, Knoxville, Tenn., as Asst. Hydr. Engr., Asst. to Engr. in Charge of Valley Mapping, etc., and Hydr. Engr.

HALL, WILLIAM HOLLAND (Assoc. M.), Durham, N.C. (Age 57) (Claims RCA 10.0 RCM 16.0) 1915 to date at Duke Univ. (formerly Trinity Coll.), as Asst. Prof. and Prof. of Eng., Director, Div. of Eng., and (since 1939) Dean, Coll. of Eng.

JAKKULA, ARNE ARTHUR (Assoc. M.), College Station, Tex. (Age 37) (Claims RCA 4.8 RCM 4.2) Sept. 1937 to Sept. 1939 Associate Prof., and Sept. 1939 to date Prof., of Structural Eng., Agricultural and Mechanical Coll. of Texas; previously Instructor in, and Asst. Prof. of, Civ. Eng., Univ. of Michigan.

JUNIOR, FRANCIS EDMUND (Assoc. M.), Chattanooga, Tenn. (Age 40) (Claims RCA 4.7 RCM 9.9) Aug. 1933 to date Asst. Highway Engr., Associate Highway Engr., Highway Engr., and Senior Highway Engr., TVA, in Charge of Highway Design Sec.

LANSFORD, WALLACE MONROE (Assoc. M.), Urbana, Ill. (Age 41) (Claims RC 10.4 D 3.7) Sept. 1927 to date with Theoretical and Applied Mechanics Dept., Univ. of Illinois as graduate student, Special Research Asst., Instructor, Associate, and (since Sept. 1937) Asst. Prof.

MILLER, CHARLES ALBERT, Traverse City, Mich. (Age 40) (Claims RCA 9.0 RCM 6.4) Sept. 1934 to date City Manager (also City Engr.), of Grayling, Mich., Kingsford, Mich., and (since Feb. 1941) Traverse City, Mich.

PEARSON, EINAR OTTO, Peoria, Ill. (Age 39) (Claims RCM 10.1) Aug. 1938 to date Associate and Partner, Austin Eng. Co., Cons. Engrs.; previously Engr., Asst. City Engr., and City Planning Engr., Peoria.

PORTAS, CORNELIO ESTARIJA (Assoc. M.), Pittsburgh, Pa. (Age 46) (Claims RCA 6.4 RCM 10.8) June 1936 to date with Morris Knowles, Inc., as Senior Asst. Engr., acting as Prin. Designing Engr.

SENOUR, CHARLES, Vicksburg, Miss. (Age 49) (Claims RCA 8.9 RCM 12.2) June 1915 to date with Mississippi River Comm., as Jun. Engr., Asst. Engr., Associate Engr., Engr. Senior Engr., Prin. Engr., and (since Feb. 1941) Head Engr.

SHATTUCK, WALTER FRANCIS, JR. (Assoc. M.), Dubuque, Iowa. (Age 35) (Claims RCA 3.7 RCM 8.1) Oct. 1939 to date Res. Engr., Sargent & Lundy; previously Res. Engr. Inspector, PWA; with Abbott Laboratories, North Chicago, Ill.

SMYTHE, JESSE VIRGIL, Indianapolis, Ind. (Age 45) (Claims RCA 1.5 RCM 8.9) March 1934 to date with State Highway Comm. of Indiana as Designer, Superv. Engr., and (since Jan. 1935) Engr. of Bridge Design.

TAYLOR, HERNDON, St. Paul, Minn. (Age 39) (Claims RCA 3.7 RCM 11.5) Nov. 1926 to date with A. Guthrie & Co., Inc., as Engr., Office Engr., Supt., etc., and (since Feb. 1937) Gen. Supt. of construction.

WAGNER, WILLIAM JOHN (Assoc. M.), Kirkwood, Mo. (Age 52) (Claims RCM 12.6) June 1929 to date with Missouri State Highway Dept., Div. 6, as Highway Designer, and (since Aug. 1937) Right-of-Way Engr., under Chf. Right-of-Way Engr.

WALLACE, WILLIAM JOSEPH, Detroit, Mich. (Age 52) (Claims RCA 7.7 RCM 16.0) 1914 to 1918 and 1918 to date with City Engr.'s Office, Detroit, as Civ. Eng. Draftsman, Asst. Paving Engr., and (since 1925) Chf. Paving Engr., Engr. of Streets.

WEISHOFF, SAMUEL, New York City. (Age 51) (Claims RCA 4.0 RCM 17.8) June 1941 to date Engr., Dreier Structural Steel Co., Long Island City; Jan. 1923 to 1935 member of firm, Weinberger & Weishoff; in the interim ill.

WHEAT, WINSTON EARL (Assoc. M.), Pensacola, Fla. (Age 48) (Claims RCA 3.9 RCM 20.1) Sept. 1935 to date County Engr., Escambia County, Fla.

WITTENBERG, FRANK, Little Rock, Ark. (Age 53) (Claims RCA 2.6 RCM 12.8) 1938 to date with Arkansas Highway Dept. as Supervisor of road-life and motor-vehicle studies and Asst. Engr. of maintenance; previously with Oklahoma State Highway Dept.

WOLF, CLEMENS WILLIAM HENRY (Assoc. M.) Louisville, Ky. (Age 36) (Claims RCA 4.7 RCM 3.2) Sept. 1938 to date Engr., Havens & Emerson (formerly Gascoigne & Associates); previously Engr., Fargo Eng. Co., Jackson, Mich.

APPLYING FOR ASSOCIATE MEMBER

BARRATT, HERBERT JOHN (Junior), Riverbend, Que., Canada. (Age 32) (Claims RCA 5.0) Sept. 1941 to date Plant Engr., Riverbend (Quebec) Mill, Price Bros. and Co. Ltd.; Dec. 1940 to Sept. 1941 Engr., Defense Industries Ltd., Montreal, Quebec; previously Asst. Engr. and Engr., British Columbia Pulp & Paper Co. Ltd., Woodfibre, B.C.

BOYD, JAMES THORNTON, Columbus, Miss. (Age 30) (Claims RCA 1.5) Sept. 1941 to date Asst. Engr. (Civil), War Dept., U.S. Engrs.; previously with Alabama Highway Dept. as Instrumentman and Project Engr.; Transitman with U.S. Dept. of Interior, Gen. Land Office, Washington, D.C.

BRINKER, RUSSELL CHARLES (Junior), Minneapolis, Minn. (Age 32) (Claims RCA 3.2) Sept. 1930 to June 1935 Instructor in, and Sept. 1940 to date Asst. Prof. of, Civ. Eng., Univ. of Minnesota; in the interim teaching at Worcester Pol. Inst. (1 year), and Univ. of Hawaii (4 years).

BRUNSMA, HERBERT, Beech Grove, Ind. (Age 39) (Claims RCA 10.0 RCM 2.6) May 1926 to date with Indiana Highway Comm., as Designer, Detailer, Estimator, Asst. Engr. of Bridge Design, and (since May 1939) Office Engr. (Design).

BUTLER, CHARLES MATHEWS, Lake Charles, La. (Age 31) (Claims RCA 4.4) Oct. 1933 to date with U.S. Engr. Dept. as Inspector of Dredging, Jun. Engr., and (since March 1941) Asst. Engr.

CAMPBELL, RAY ANDERSON (Junior), Laramie, Wyo. (Age 33) (Claims RCA 5.7) Jan. 1937 to April 1939 in private practice, general engineering and contracting, April 1939 to date Engr. and Constr. Supt., Tri-State Lumber Co., and (since Feb. 1940) its successor Deal Lumber Co.; previously Engr. and Foreman on bridge construction with John Krahey, Buffalo, Wyo.

CENSULLO, XAVIER FRANCIS (Junior), Union City, N.J. (Age 32) (Claims RCA 5.0 RCM 2.6) March to June 1941 Selectee, U.S. Army; June 1941 to date Lieut. (j.g.), Public Works Dept., U.S. Navy.; previously (short periods) with various companies as Asst. Supt., Job Engr., Constr. Engr., etc.

CHAMBERLAIN, LAWRENCE EARL, State College, Pa. (Age 27) (Claims RCA 1.3) Sept. 1941 to date Supervisor, Civ. Eng. courses, Eng. Defense Training Program, Pennsylvania State Coll.; previously Civ. Engr. (Constr.), Herlihy Mid-Continent Co., Chicago, Ill.; Sales Engr., Steel Sheet Piling Dept., Inland Steel Co., Chicago.

COMINS, HARRISON DURGIN (Junior), Columbia, Mo. (Age 32) (Claims RCA 1.8) Sept. 1937 to June 1941 Instructor in, and Sept. 1941 to dat Asst. Prof. of, Civ. Eng., Univ. of Missouri.

COXE, SIMEON OLIVER, JR., Knoxville, Tenn. (Age 31) (Claims RCA 2.2 RCM 2.4) Aug. 1934 to date with TVA as Under Eng. Aide, Jun. Eng. Aide, Asst. Eng. Draftsman, Eng. Draftsman, Jun. Structural Engr., Prin. Eng. Draftsman, Asst. Structural Engr., and (since June 1941) Associate Structural Engr.

DAVIS, WILSON LORENZO, Sacramento, Calif. (Age 37) (Claims RCA 4.3) Sept. 1935 to Jan. 1937 and Aug. 1937 to date with U.S. Engr. Office as Topographic Draftsman, Senior Eng. Draftsman (Civil), and (since March 1938) Senior Engr. Draftsman to Associate Engr.; in the interim Engr., Peterson Constr. Co., Minneapolis, Minn.

ELLWOOD (Formerly KAHAN), ARTHUR (Junior), New York City. (Age 32) (Claims RCA 3.9 RCM 2.3) Aug. 1941 to date Engr. (Squad Boss), Frederick R. Harris, Cons. Engr.; previously Asst. Engr. Designer, Board of Water Supply, New York City; Asst. Engr., U.S. Engr. Office, New York City and Binghamton, N.Y.

ENKE, GLENN LAVINE (Junior), Sacramento, Calif. (Age 32) (Claims RC 11.1 D 9.3) Sept. 1931 to date with California Div. of Highways, as Asst. Bridge Designing Engr., Associate Bridge Engr., and (since Jan. 1941) Engr. of Design.

EVANS, DANIEL (Junior), Benin City, Nigeria. (Age 32) (Claims RC 4.7) Dec. 1936 to date Executive Engr., Public Works Dept., Govt. of Nigeria; previously with Sir R. Owen Williams, London, England, as Asst. to Res. Engr., and Deputy Res. Engr.

GAY, ROBERT LEROY, Anniston, Ala. (Age 36) (Claims RCA 6.9) April 1941 to date Asst. Layout Engr., J. B. Converse & Co., and A. C. Polk; July 1940 to April 1941 Gen. Supt., WPA; previously Bridge Detailer, Georgia Highway Board; Engr. Inspector, PWA; Reinforcing Steel Foreman, E. I. du Pont de Nemours & Co., Inc.; Bridge Inspector, Mississippi State Highway Comm.

GRANT, NYE, Columbus, Ohio. (Age 33) (Claims RCA 7.5) Oct. 1939 to date with U.S. Geological Survey as Jun. Hydr. Engr.; previously Div. Asst. Right-of-Way Engr., Ohio Dept. of Highways.

GRIFFIN, ROBERT HARDY (Junior), Oakland, Calif. (Age 32) (Claims RCA 8.3) June 1931 to date with U.S. Forest Service, as Jun. Engr., Asst. Topographic Engr., and (since Aug. 1939) Asst. Civ. Engr.

HANSEN, HOWARD JAMES, New Orleans, La. (Age 32) (Claims RCA 3.8) April 1937 to date with Southern Pine Association as Field Engr., and (since Sept. 1941) Cons. Engr.; Sept. 1941 to date also Instructor in Experimental Eng., Tulane Univ.; previously Sales Engr., Edward Hines Lumber Co.

HENDRIX, HUBERT LEE, Muskogee, Okla. (Age 40) (Claims RCA 5.4 RCM 2.6) May 1941 to date Chf. Engr., Holway and Cochrane; previously Designer and Chf. Constr. Engr., Holway & Neuffer, Tulsa, Okla.; Designer of bridges, Ash, Howard, Needles & Tammen, Kansas City, Mo.

HESELTON, FRANK RICHMOND (Junior), York, Pa. (Age 29) (Claims RCA 3.1) Sept. 1938 to date with U.S. Engr. Office, as Topographic Draftsman, Jun. Engr., and (since March 1941) Asst. Engr.; previously Bldg. Inspector, Boston Woven Hose and Rubber Co., Cambridge, Mass.

HUFFMAN, JAMES WILLIAM, Humboldt, Tenn. (Age 37) (Claims RCA 5.5 RCM 10.4) April 1941 to date Senior Constr. Supt. for Constr. Quartermaster, Wolf Creek Ordnance Plant, Milan, Tenn.; previously Supt., Gage Bros. & F. M. Reeves and Sons, Inc.; in private practice of general contracting.

HYDE, GEORGE EMMONS (Junior), Bonneville, Ore. (Age 32) (Claims RCA 3.7) June 1939 to date Eng. Aide, Jun. Civ. Engr. and Asst. Hydr. Engr., Bonneville (Ore.) Hydraulic Laboratory, U.S. Engr. Office; previously Jun. Eng. Aide and Eng. Aide, U.S. Waterways Experiment Station, Vicksburg, Miss.; Sales Engr., George D. Roper Corporation, New York City.

KNUDSEN, CLARENCE VIRGIL (Junior), Lincoln, Nebr. (Age 32) (Claims RCA 4.2) Aug. 1933 to June 1934 and Sept. 1934 to date with Nebraska Dept. of Roads and Irrigation, as Tracer, Draftsman, Bridge Draftsman, Bridge Detailer, Bridge Designer, Senior Bridge Designer, and (since May 1941) Senior Engr.

KRING, CHARLES UDELL (Junior), St. Georges, Del. (Age 31) (Claims RCA 3.5 RCM 0.4) June 1941 to date with Parsons, Klapp, Brinckerhoff & Douglas, New York City, as Asst. Res. Engr. on St. Georges Bridge, Del.; previously graduate student and Instructor in Civ. Eng., Univ. of Illinois; Constr. Engr. and Supt., Ben Hur Constr. Co., St. Louis, Mo.

MACDONALD, DONALD NEWELL, Sacramento, Calif. (Age 37) (Claims RCA 10.5) Feb. 1935 to date with Southern Pacific Co., as Instrumentman, and (since Jan. 1938) Asst. Engr.

MARSTON, GEORGE ANDREWS (Junior), Amherst, Mass. (Age 33) (Claims RCA 1.0) Sept. 1933 to date with Massachusetts State Coll., as Instructor, Dept. of Mathematics and Civ. Eng., and (since Sept. 1937) Asst. Prof. of Eng., Dept. of Eng.

PRICHARD, ROBERT LEO (Junior), Macon, Ga. (Age 30) (Claims RCA 0.6 RCM 5.4) April to Oct. 1941 Associate San. Engr., and Oct. 1941 to date Civ. Engr. (P-4), Utilities Div., U.S. War Dept., Replacement Center, Camp Wheeler, Ga.; previously Dist. Field Engr., FWA, PWA, Dist. 4, Georgia; with C. H. Cook, Inc., Gen. Contrs., Buena Vista, Ga., as Office Manager; Res. Engr., J. B. McCrary Co., Inc., Mun. Engrs., Atlanta.

ROBERTSON, ROBERT EMMETT, JR., Baltimore, Md. (Age 34) (Claims RCA 4.3 RCM 0.5) At present with U.S. Army; Oct. 1940 to Sept. 1941 Senior Structural Designer, Whitman, Requardt & Smith; June 1939 to Sept. 1940 Structural Engr., Van R. P. Saxe, Cons. Engr.; previously Engr., Bethlehem Shipbuilding Co.; Structural Draftsman and Asst. Field Engr., American Bridge Co., Pittsburgh, Pa.

ROCKEFELLER, EDWARD JOHN (Junior), Woodbridge, Conn. (Age 33) (Claims RCA 2.7) Dec. 1936 to date with Clarence M. Blair, Inc., as Transitman, Estimator, Asst. Engr., and (at present) Chf. of Party.

SHERIDAN, EMMETT HUGH, Santa Fe, N.Mex. (Age 34) (Claims RC 2.3) July 1930 to date with U.S. Coast & Geodetic Survey as Deck Officer, Jun. Officer, and (at present) Chf. of first-order level party.

SORING, ARTHUR RANDOLPH (Junior), Honolulu, Hawaii. (Age 32) (Claims RCA 4.7 RCM 1.2) May 1933 to date with U.S. Engr. Dept., as Surveyman, Jun. Engr., Asst. Engr., Associate Engr., and (since Aug. 1941) Engr.

STANCER, WILLIAM ARTHUR, Tacoma, Wash. (Age 42) (Claims RCA 14.3 RCM 3.9) Nov. 1939 to date with Guy F. Atkinson Co., Enumclaw, Wash., as Asst. to Supt., Mud Mountain Dam; previously Traffic Inspector, Bureau of Motor Carriers, Interstate Commerce Comm., Washington, D.C.; Engr., Traffic Supervisor and Asst. State Traffic Engr., Washington Highway Dept., Olympia.

STEVENS, DUDLEY FIELD (Junior), San Francisco, Calif. (Age 30) (Claims RCA 2.5 RCM 0.9) Sept. 1937 to date with *Western Construction News*, as Asst. Editor, and (since Jan. 1941) Editor; previously Timekeeper and Job Engr., Fredericksen & Westbrook, Sacramento, Calif.

WAIT, JOHN RUSSELL, JR. (Junior), Houston, Tex. (Age 31) (Claims RCA 4.1 RCM 2.5) 1939 to date with J. S. Abercrombie Co., as Engr., and (since 1940) Supt.; previously with United Gas Pipe Line Co., as Rodman, Chainman, Field Engr., and Engr., etc.

WALKER, OTIS HAROLD (Junior), Kirkwood, Mo. (Age 32) (Claims RCA 8.1) July 1936 to date Special Representative and Asst. to Sales Mgr., Missouri Portland Cement Co., being Consultant in Technical Service Dept.

ZERBE, JAMES JACOB (Junior), Pearl Harbor, Hawaii. (Age 33) (Claims RCA 4.2) May 1935 to May 1936 and June 1940 to date with U.S. Navy, at present being Lieut. (j.g.), U.S.N.R., acting as Asst. Public Works Officer, Res. Officer, and (since April 1941) Asst. Res. Officer in Charge; in the interim with Austin Eng. Co., Bryant & Detwiler Co., and City of Detroit, etc.

APPLYING FOR JUNIOR

DONNAN, WILLIAM WALTER, El Centro, Calif. (Age 30) (Claims RCA 0.7) Aug. 1934 to date with U.S. Dept. of Agriculture, SCS, as Senior Foreman, Eng. Aide, Jun. Engr., and (since March 1941) Asst. Civ. Engr.

GAFFNEY, CHARLES MALCOLM, San Antonio, Tex. (Age 30) May to Sept. 1941 Asst. Engr. (P-2 Civ. Service rating) and Sept. 1941 to date Associate Engr. (P-3) for Constr. Quartermaster, Camp Bowie, Tex.; previously Field Engr., with Koch & Fowler, Cons. Engrs., Camp Bowie, Tex.

HECKMILLER, IGNATIUS ADAM, Indianapolis, Ind. (Age 30) (Claims RCA 4.0) Aug. 1937 to date Asst. Hydr. Engr., U.S. Geological Survey; previously Miscellaneous Constr. Foreman, National Park Service, Dept. of Interior.

JASKAR, ADE EUGENE, Enumclaw, Wash. (Age 29) Feb. 1938 to date with U.S. Engr. Dept., as Inspector, and (since Sept. 1941) Jun. Geologist.

KAAR, PAUL HARRY, Ancon, Canal Zone. (Age 25) Oct. 1938 to date with The Panama Canal as Student Structural Engr., and after April 1939 also Jun. Structural Engr.; previously Instrumentman and Chf. of Surveying Party, Cities Service Oil Co., Whiting, Ind.

KOCAL, STANLEY JOHN, Santa Clara, Calif. (Age 28) Sept. 1941 to date Instructor in Civ. Eng., Santa Clara Univ.; previously Highway Engr., Illinois Highway Dept.; Instructor, North Dakota Agricultural Coll.; Examination Draftsman, Michigan Civil Service Comm.; Cartographic Draftsman, Planning Div., Michigan State Highway Dept.

LUCK, DAVIS ROYALL, San Jose, Costa Rica. (Age 27) (Claims RCA 1.8) March 1941 to date Jun. Highway Engr. (P-1), FWA of PRA, Highway Transport Div.; Sept. 1940 to March 1941 Eng. Aide (SP-5), Highway and R.R. Div., TVA, Chattanooga, Tenn.; previously Jun. Structural Engr., Golian Steel & Iron Co., Atlanta, Ga.; Jun. Engr. Inspector, Region 3, U.S. PWA, Atlanta.

MERRELL, JOHN CAMP, JR., Indianapolis, Ind. (Age 26) Nov. 1938 to date Jun. Engr., U.S. Geological Survey; previously Draftsman, Plans Dept., Minnesota Highway Dept.

VONDER BRUEGGE, HENRY JOHN, St. Louis, Mo. (Age 30) (Claims RCA 2.9) May 1939 to date Engr., Bemis Bros. Bag Co.; June 1933 to Jan. 1939 Designer, C. A. Davies Eng. Co.; previously Layout Man with E. H. Mittendorf, Contr.

1941 GRADUATES

ALA. POL. INST.
(B.S. in C.E.)

	Age
JAMISON, HAROLD LENARD	(23)

CASE SCHOOL OF APPLIED SCI.
(B.S. in Civ.Eng.)

AMBROSE, HARRY HARWOOD	(24)

COLUMBIA UNIV.
(M.S. in. C.E.)

BROWN, LEROY ALEXANDER (Also 1940 B.C.E., Clarkson Coll.)	(22)

GA. SCHOOL TECH.
(B.S. in Civ.Eng.)

WALTON, NORMAN JAMES	(25)

STATE UNIV. OF IOWA
(B.S. in C.E.)

BURMAN, EDWARD WILLIAM*	(24)

McGILL UNIV.
(B.Eng., Civ.)

VON COLDITZ, HERBERT WARE	(24)

UNIV. OF MICH.
(M.S. in C.E.)

SZETO, CHEW CHEUK (Also 1938 B.C.E., Hangchow Univ.)	(27)

(B.S.E., Transportation)

LOUGHIN, MARSHALL IMOGENE	(22)

COLL. OF CITY OF N.Y.
(B.C.E.)

CHESTER, ISRAEL	(20)

OKLA. A. & M. COLL.
(B.S. in Civ.Eng.)

EDGE, ROBERT CLARK	(24)
MCCORMICK, ROBERT KENNETH	(23)

UNIV. OF UTAH
(B.S. in Civ.Eng.)

HOGGAN, HOWARD RALPH	(24)

VIRTUAL GRADUATES
Requirements completed
Degree not yet conferred

UNIV. OF KANS.
(B.S. in Civ.Eng.)

PACE, CLYDE WILSON, JR.	(24)
PAULETTE, ROBERT GRIEBIE	(21)

APPLYING FOR AFFILIATE

AVERILL, WALTER ALBERT, Seattle, Wash. (Age 41) Dec. 1924 to date Editor, *Pacific Builder and Engineer.*

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men and Positions Available

These items are from information furnished by the Engineering Societies Personnel Service, with offices in Chicago, Detroit, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 141 of the 1941 Year Book of the Society. To expedite publication, notices of positions available should be sent direct to the Personnel Service, 31 West 39th Street, New York, N.Y. Employers and applicants should address replies to the key number, care of the New York Office, unless the word Chicago, Detroit, or San Francisco follows the key number, when it should be sent to the office designated.

Design

Civil Engineer; Jun. Am. Soc. C.E.; 22; single; B.C.E., New York University, College of Engineering, 1939; 2 years design of pump plants, dams, and buildings. Desires work in building (design or construction) field. Must be in Metropolitan Area. Available on two weeks' notice. C-890.

Executive

Engineering Executive; M. Am. Soc. C.E.; with exceptionally broad experience in construction, financial management, and organizational work; desires permanent connection with an industry or institution where standards are high and where clear analysis, guided by extensive business and professional experience, will be useful. C-888.

Executive Engineer; M. Am. Soc. C.E.; married, no dependents; experienced in design and construction of dams, pipe lines, sewer systems, buildings, filters, railway location, and construction, highways, hydroelectric power plants, pumping stations, mining; available at once. C-889.

Junior

Civil Engineer; Jun. Am. Soc. C.E.; 25; married; B.S. in C.E., Swarthmore College, 1940; experienced in road construction and the distillation of tar and tar by-products. Will take any kind of engineering work. East preferred. C-893.

Civil Engineer; Jun. Am. Soc. C.E.; 25; B.S.C.E.; M.S.C.E.; single; Selective Service classification 11; American citizen; experienced in designs and inspection of airports and army camps; very good draftsman; desires position in defense work in Latin America. Can speak, read, and write Spanish as fluently as native. C-891.

Graduate Civil Engineer; Jun. Am. Soc. C.E.; 29; married; 3 years highway experience; 5 years junior engineer, U.S. Engineer Corps and Public Roads Administration. Would like opportunity as structural engineer or as office engineer assisting contractor. Excellent scholastic records. Available on month's notice. C-892.

Positions Available

Junior Construction Engineer, not over 32, with one or two years' experience in the field. Will assist erection engineer on construction of a supply depot. Timber construction experience desirable. Salary, \$2,600–\$3,900 a year. Location, Pennsylvania. Y-9177.

Structural Engineers with experience in design of reinforced concrete structures for temporary work, eight to nine months. Salary, \$3,200–\$4,600 a year. Location, South. Y-9180.

Engineer who is qualified and competent to design and assist in the preparation of plans and to supervise work of a reinforced concrete seaplane ramp. Location, South. Y-9201.

Structural Draftsman, young recent graduate, for drawing buildings under supervision, also sketch work. Will accept older man. Salary, \$1,800–\$3,000 a year, depending upon experience. Location, New York, N.Y. Y-9210.

Assistant Engineer, 30–35, who has had considerable experience in building construction work which should have included construction of warehouses and docks, barracks, and houses. Duration, six months to two years. Salary, \$3,600 a year. Location, foreign. Y-9230.

Junior Engineer, 26–32. Should be college graduate of recognized technical school, along the lines of structural engineering. Salary, \$3,000 a year. Duration, six months to two years. Location, foreign. Y-9231.

Construction Superintendent, graduate engineer, with a substantial background. Prefer someone with defense work experience. Location, South. Y-9260.

Engineers available for employment on hydroelectric power studies on two large river systems. Duration, a year to a year and a half. Salaries: From draftsmen, \$1,800–\$2,160 a year, to engineer in charge of studies, \$3,800–\$4,600 a year. Location, South. Y-9261.

Timekeeper, graduate civil engineer, 35–40, experienced in heavy construction work, preferably dock work. Salary, \$2,080–\$3,120 a year. Location, New York, N.Y. Y-9263.

General Superintendent with a thorough knowledge of building construction, including warehouses, barracks, bungalows; also experience in paving runways, rock crusher plant operations, pile foundations, wharves and docks, breakwater revetment. Must be able to coordinate and administer various types of construction involved in the base contract, and must know enough about each type of construction to be able to give direction. Salary, \$7,500 a year. Location, foreign. Y-9264.

Designer for sewage disposal plant and water treatment and distribution system. Temporary. Salary, \$4,100–\$5,200 a year. Location, foreign. Y-9280.

Draftsmen, Civil Engineers. (a) Recent graduate for general layout to develop into steel detailer. (b) Experienced Structural Steel Draftsman for steel detailing work. Salary open. Permanent. Location, New York, N.Y. Y-9284.

General Construction Superintendent to take charge of field construction of large munitions plant. Prefer man with experience in present national defense projects. Headquarters, New York, N.Y. Y-9288.

Instrumentmen, Draftsmen, and Rodmen for a water company. Write for application blanks. Location, Connecticut. Y-9294.

Structural Steel Draftsmen (4); Concrete Designers (4); Headquarters, New York State. Y-9295.

Graduate Civil Engineer who can estimate and design structural steel and reinforced concrete for specialists in the design and construction of office and bank buildings. Location, Pennsylvania. Y-9305.

Graduate Civil Engineer, 30–40, with actual design and construction experience in structural steel buildings, waterfront facilities such as docks and floats, reinforced concrete and various miscellaneous installations, such as water, sewage, and electric power systems. Should have good personality and original and flexible mind. Permanent. Salary, \$3,600–\$4,200 a year. Location, New York Metropolitan Area. Y-9311.

Recent Graduate Civil Engineer who is interested in teaching, particularly surveying, strength of materials, or soil mechanics. Must have been in upper half of his class. Salary, \$2,200–\$2,600 a year. Nine months' work. Location, New York, N.Y. Y-9325.

Reinforced Concrete and Piping Designers. Salary, \$4,680 a year. Location, New York, N.Y. Y-9352.

Assistant Office Engineer, civil engineer to assist in estimating, checking designs, contact contractors, etc. Salary, \$2,100–\$2,400 a year. Location, New York, N.Y. Y-9362.

Structural Squad Leader to supervise a group of designers engaged in designing structural steel and reinforced concrete mill buildings, power plants, and timber structures. Must have had steel mill experience and a knowledge of rigid-frame design. Salary, \$4,800 a year. Location, Middle West. Y-9374.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room will be found listed here. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

America. By David Cushman Coyle. Washington (D.C.), National Home Library Foundation, 1941. 91 pp., 7 × 4½ in., cloth, 25 cents.
An interesting and inspiring appraisal of America's position in the international crisis.

Design of Piping Systems, Expansion Stresses and Reactions in Piping Systems. Published by M. W. Kellogg Company, Jersey City, N.J.; 225 Broadway, New York, 1941. 97 pp., illus., diagrs., charts, tables, 11½ × 8½ in., cloth, \$10.
The general method of analyzing pipe lines for flexibility presented in this manual is applicable to piping systems of almost any shape or configuration such as are needed in the power, oil refinery, and chemical industries. The derivation and application of formulas for expansion stresses and reactions are presented in a detailed manner, design data are furnished, and there is a bibliography.

Great Britain, Dept. of Scientific and Industrial Research. Building Research. Wartime Building Bulletin No. 15A, Supplement to Bulletin No. 15. His Majesty's Stationery Office, London, 1941. 14 pp., diagrs., charts, tables, 11 × 8½ in., paper. (Obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 15 cents.)
This bulletin supplements a previous one upon the design of one-story war-industry factories, by describing modifications in the interest of camouflage treatment. It also presents a new reinforced-concrete design, introduced for steel economy.

Guide to Library Facilities for National Defense. Revised Edition. Edited by Carl L. Cannon for the Joint Committee on Library Research Facilities for National Emergency. Chicago, American Library Association, 1941. 448 pp., 11 × 8½ in., paper.
Holdings of approximately 800 libraries, in so far as they relate to national defense subjects, are described in the revised edition. Every type of library—university, college, reference, public, governmental, industrial, business, etc.—has cooperated with the survey of resources and made its facilities available to research workers in the present emergency.

Highway Curves, 3 ed. By H. C. Ives. John Wiley & Sons, New York, 1941. 380 pp., diagrs., maps, charts, tables, 7 × 4 in., cloth, \$4.
A presentation of the theory and practice of highway curves as practiced in this country is presented in this manual, together with the mathematical tables required in road building. The new edition has been revised and four new chapters added, dealing with the selection of a curve and spiral; curbs, crowns, and grades; traffic lanes and divided highways; and construction stakes.

Materials Testing, Theory, Practice and Significance of Physical Tests on Engineering Materials. By H. J. Gilkey, G. Murphy, and E. O. Bergman. McGraw-Hill Book Co., New York and London, 1941. 185 pp., illus., diagrs., charts, tables, 11½ × 8½ in., cloth, \$2.75.
The field of materials testing work in colleges is covered comprehensively in this laboratory manual, from general observations on test procedures to suggestions upon the conduct of a course of instruction, and on typical final examinations. More material is included than is likely to be used in any one laboratory, in order to provide for wider use. Answers are given for the many supplementary questions, and there is an unusually complete subject index.

Personnel Management, Principles, Practices, and Point of View, 3 ed. By W. D. Scott, R. C. Clothier, S. B. Mathewson, and W. R. Spriegel. McGraw-Hill Book Co., New York, 1941. 589 pp., illus., diagrs., charts, tables, 9½ × 6 in., cloth, \$4.
Completely revised and rearranged, the new edition of this text presents a comprehensive outline of up-to-date principles, practices, and instruments in the important relationships of management, work, and workers. The revision includes a discussion of modern personnel practices and procedures supported by a detailed survey of 231 companies employing more than 1,750,000 workers.

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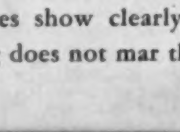

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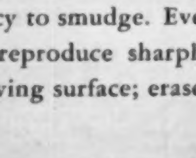

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CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Publications (Except Those of the American Society of Civil Engineers) in This Country and Foreign Lands

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own file, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page to members of the Founder Societies (30 cents to all others), plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

CONCRETE, COSTS. Types and Costs of Reinforced Concrete Bridges, W. A. Failhurst. *Structural Engr.*, vol. 19, no. 9, Sept. 1941, pp. 150–158. Set of graphical charts and diagrams providing rapid means of comparing suitability and costs of many types of reinforced concrete bridges with varying spans and clearance heights for particular site conditions.

CONNECTICUT. Supervision of Dams and Reservoirs in Connecticut, C. N. Blair. *New England Water Works Assn.—J.*, vol. 55, no. 1, Mar. 1941, pp. 12–22. Historical review of practice of State of Connecticut in supervision and inspection of construction and maintenance of dams and reservoirs.

HIGHWAY, GERMANY. Spitzwinklige Ueberfuehrungen einer Reichsstrasse ueber eine zweigleisige Bahn, H. Vonhof. *Bautechnik*, vol. 19, no. 16, Apr 11, 1941, pp. 173–178. Design and construction of overhead grade-separation structure carrying German highway over double-track railroad line at intersection angle of about 20 deg; details of retaining walls, piers, and bridge abutments.

HIGHWAY, URUGUAY. Puentes y caminos en el Uruguay, E. Sanchez Gonzales. *Montevideo Facultad de Ingenieria—Bul.*, vol. 2, no. 1, June 1941, pp. 32–49. Bridges and highways in Uruguay; review of achievements, compiled in 1940 for a foreign periodical, but not published; progress of construction on various highways; some cost data included. Bibliography.

LIFT. Hubbruecke ueber einen Kanal, Pfeiffer. *Bautechnik*, vol. 19, no. 22, May 23, 1941, pp. 233–236. Design and construction of steel-truss lift bridge of about 12-m clear span having vertical lift of 2.4 m; location not given.

MILITARY. Die Brueckenbauten der Heeresbautruppe im heutigen Kriege, Klingbeil. *Bautechnik*, vol. 19, no. 17/18, Apr. 18, 1941, pp. 186–188. Review of recent German practice in construction of military bridges and emergency restoration of war-damaged bridges.

MILITARY. Recent Field Improvisations, W. G. Trainer. *Military Engr.*, vol. 33, no. 190, July-Aug. 1941, pp. 332–334. Features of U.S. Army improvised suspension bridges; diagram for computing cable loadings; improvised footbridges; improvised swamp crossings; improvised semi-permanent fixed bridge.

NATURAL GAS PIPE LINES, RIVER CROSSINGS. Building Bent-Type Pipe Line Bridge. *Gas*, vol. 17, no. 8, Aug. 1941, p. 22. Brief description of bridge crossing 180-ft stream near city of Houston, Tex., to carry 16-in. line of Houston Natural Gas Co.; span of 55 ft between bents was chosen; cost estimated as 50% of cost of suspension bridge; pipe line was placed at elevation of 2 ft higher than high-water flood stage.

PLATE GIRDER, GREAT BRITAIN. New Steel Bridge, 200 Feet Main Span, B. C. Hammond. *Structural Engr.*, vol. 19, no. 8, Aug. 1941, pp. 132–144. Design and construction of new steel cantilever bridge in Great Britain (locality not indicated), consisting of anchor spans 85 ft 6 in. each, cantilever arms 46 ft 1 1/2 in. each, and central suspended span 107 ft 9 in.; pier construction details; abutments; reinforced concrete viaduct approach; design of deck. Before joint meeting of Instn. Structural Engrs., Instn. Civ. Engrs., and Instn. Mun. and County Engrs.

RAILROAD. Bridge Construction Features Line Change on S.P., G. W. Rear. *Ry. Eng. & Maintenance*, vol. 37, no. 9, Sept. 1941, pp. 598–600 and 606. Author describes outstanding features of eight bridges being built on 30-mile line diversion of Southern Pacific Railroad around Shasta reservoir in California; bridges have combined length of 22,202 lin ft and include highest double-track, double-deck bridge in world, Pit River Bridge; also stresses features of painting. Before Am. Ry. Bridge & Bldg. Assn.

RAILROAD, FAILURE. Cause of Soo Bridge Failure Not Yet Determined. *Ry. Age*, vol. 111, no. 16, Oct. 18, 1941, pp. 611–614. Article discusses recent failure of north leaf of Canadian Pacific's twin-leaf bascule bridge over one of the channels of United States ship canal at Sault Ste. Marie, Mich.

RAILROAD, FAILURE. Historic Accidents and Disasters. *Engineer*, vol. 172, nos. 4461, 4462, and 4464, July 11, 1941, pp. 18–20; July 18, pp. 34–35; and Aug. 1, pp. 66–67. Account of collapse of Tay Bridge, December 28, 1879, near Dundee and wreck of train crossing it during great storm; bridge was 3,450 yd long; single line of track was carried across 85 spans consisting of lattice girders; bridge was really series of bridges, of different design and construction, linked together.

STEEL ARCH, NIAGARA FALLS, N.Y. Cables Carry Niagara Arch to Closure. *Eng. News-Rec.*, vol. 127, no. 9, Aug. 28, 1941, pp. 288–293. Methods and equipment used in construction of largest hingeless steel arch span in world, 950 ft long, to replace bridge over gorge below Niagara Falls; falsework being impossible, plate girder ribs were supported during erection by elaborate cable system; rocker bents on abutments provided common point of attachment for forward and backstay cables; rib traveler erected pieces weighing 75 tons; closure section installed by jacking; erection diagram.

STEEL, PORTABLE. "Butterley" Standard Bridge. *Engineering*, vol. 151, no. 3933, May 30, 1941, pp. 427–428; see also *Engineer*, vol. 171, no. 4455, May 30, 1941, pp. 356–357. Particulars of new design; material for both light footbridges and those of wide span for heavy loads is made up of standard units; five components required for heavy bridges, while four suffice for footbridge; bridges may be either "through" type or "deck" type.

STEEL TRUSS, GERMANY. Einiges ueber die Gestaltung von grossen Fachwerkbalkentraegern, G. Schaper. *Bautechnik*, vol. 18, no. 55, Dec. 20, 1940, pp. 631–633. Study of various types of steel trusses that were used in bridge construction in Germany.

STEEL, WELDING. Investigations to Improve Field Splicing Conditions of Welded Bridge Girders, G. Bierett. *Am. Inst. Steel Construction—Report*, no. 165, Mar. 1941, 45 pp., supp. plates. Translation of Bulletin No. 10 of German Committee on Steel Construction, analyzing stress conditions in field splices of welded bridge girders and supplying directions for bringing about more favorable conditions for their execution; shrinkage stresses in welded girders; measuring instruments and measuring arrangements; measurements at web and flange plates; recommended welding procedure.

STEEL, WELDING. Welded Bridge Practice in Europe, L. Grover. *Eng. News-Rec.*, vol. 127, no. 5, July 31, 1941, pp. 166–170. Review of French, Belgian, and English practices on welded bridges; elimination of shrinkage stresses; butt welds; ribbed flange plates for girders; tees for web stiffeners and reinforced H-sections; Joncherolles bridge near Paris; plate girder highway bridge across Meuse at Ougree, Belgium; half-through plate girder railway bridge of London Passenger Transport Board at Hainault, near London; welded rigid frame bridge over Boulevard Ney in Paris.

SUSPENSION, AUSTRALIA. Phillip Island Suspension Bridge, M. G. Dempster. *Commonwealth Engr.*, vol. 28, nos. 11 and 12, June 2, 1941, pp. 319–323, and July 1, pp. 351–357. Design and construction of highway suspension bridge, having main span 550 ft long, between San Remo and Newhaven, on Phillip Island, Westernport Bay; economic justification for bridge; approach span substructure; piles and pile driving; approach span superstructure; suspension span details; suspension towers; cables; construction of suspension span floor system.

SUSPENSION, MAINTENANCE AND REPAIR. Ailing Suspension Bridge Restored, D. B. Steinman and J. London. *Eng. News-Rec.*, vol. 127, no. 11, Sept. 11, 1941, pp. 359–362. Welding and other methods and equipment used in strengthening and modernization of 35-year-old suspension bridge over Ohio River at Steubenville, Ohio, comprising center span of 700 ft, two suspended side spans of 324 ft and 276 ft, and 496 ft of steel viaduct approach spans of trusses and girders; restoration of corroded cables; friction hitch and tie backs that gripped and held cables taut while rusted ends were cut off and replaced; installing new suspenders.

SUSPENSION, STABILIZATION. Stability of Suspension Bridges. *Engineer*, vol. 171, no. 4458, June 20, 1941, pp. 400–401. Editorial discussion with reference to failure of Tacoma Bridge; it is pointed out that tendency of suspension bridge design in recent years has been towards type that suffered many disasters in past; more recently there has been progressive return towards less rigid type of bridge; but inherent danger of lightening structure seems, at least in bolder recent designs, to have been overlooked.

VIADUCTS, STEEL. Old Viaduct Reinforced by Welding, G. G. Landis. *Eng. News-Rec.*, vol. 127, no. 5, July 31, 1941, pp. 164–165. Strengthening viaduct of New York, Chicago and St. Louis Railroad, at Conneaut, Ohio, 1,320 ft long, by replacing with new riveted girders and reinforcing with additional material applied by arc welding; new bracing added to viaduct towers on both longitudinal and transverse faces; column strengthening by welding angles on both sides.

BUILDINGS

DEMOLITION. Notes on Demolitions Carried Out in Large Manufacturing Town, After Recent Air Raid. *Roy. Engrs. J.*, vol. 55, June 1941, pp. 161–169. Review of British experience with demolition of buildings damaged by air raids; especially those that have been burnt out, demolition of buildings to create fire breaks; examples of demolitions that were carried out.

STRUCTURES, BOMBING EFFECT. London Letter on Buildings Under Bombing, O. Bondy. *Eng. News-Rec.*, vol. 127, no. 7, Aug. 14, 1941, pp. 214–215. London report on structural damage from bombing stating that oblique hits on walls are more common than vertical hits on roofs, damage even from same size bombs is extremely variable, fireproofing of steelwork is particularly important, and bearing wall buildings are especially vulnerable; material thicknesses required for bomb protection.

CITY AND REGIONAL PLANNING

LONDON, ENGLAND. City of London Reconstruction, S. Bylander and H. Boddington. *Structural Engr.*, vol. 19, no. 6, June 1941, pp. 93–111. General discussion of proposed plan for reconstruction of city of London, after current war, along modern lines.

CONCRETE

CAMPS, MILITARY. New Type of Concrete Hut. *Concrete & Constr. Eng.*, vol. 36, no. 8, Aug. 1941, pp. 324–327. Features of cheap weatherproof huts built of precast concrete units reinforced with hessian; method of erecting hut.

CONSTRUCTION, COLD WEATHER. Concreting in Zero Weather, H. H. Nicholson. *Western Construction News*, vol. 16, no. 7, July 1941, pp. 206–208. Experience in concrete placement during extremely cold weather at Fort Peck Dam; details of heating plant; temperature specifications; heating schedule; preheating of aggregates in wood storage bins by steam jets which are pushed into material at 10-ft centers; gas stoves for providing artificial heat in and around forms to bring temperature up to 50 F during and after pour; concrete protection.

CONSTRUCTION, FORMS. Forming Details and Practices for Architectural Concrete, A. J. Boase. *Eng. News-Rec.*, vol. 127, no. 7, Aug. 14, 1941, pp. 240–242. Design and construction of forms for architectural concrete; spacing of studs and wales; corner framing detail showing method of locking corner to prevent leakage; allowing for

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swelling at openings; handling of construction joints; blocking and bracing of window forms; horizontal construction joint details showing method of producing straight level joints without offsets.

DESIGN. Combined Chart of Bending Factors, G. G. Meyerhof. *Concrete & Constr. Eng.*, vol. 36, no. 7, July 1941, pp. 274–277. Graphical chart for rapid design of reinforced concrete slabs and beams on basis of maximum permissible concrete and steel stresses and modular ratio; moment of resistance and maximum concrete and steel stresses in singly-reinforced rectangular section subjected to given moment; numerical examples.

DRYDOCKS. Navy's Huge Drydocks, D. H. Young. *Construction Methods*, vol. 23, no. 8, Aug. 1941, pp. 42–47, 98, 100–101, 102, 104, and 105. Methods and equipment used in construction of three shipbuilding drydocks, 1,100 ft long and 150-ft wide, located at Philadelphia Navy Yard and Norfolk Navy Yard; coordination of floating equipment within dredged basin; operation of new tremie method of placing concrete under water; concreting barges; central mixing plant; pipe line transportation of concrete; concrete progress.

MIXERS. Portable Concrete Mixer. *Engineer*, vol. 172, no. 4465, Aug. 8, 1941, p. 87. Illustrated description of mixer supplied by Blaw-Knox Ltd., in two sizes, with net batch capacities of 5- and 7-cu ft capacity, respectively.

READY-MIXED, ALABAMA. Roquemore Expands in Ready-Mix Field. *Pit & Quarry*, vol. 34, no. 1, July 1941, pp. 124–126. Features of plant at Montgomery, Ala.; supplementary note on portable plant operated by same company to supply 40,000 cu yd of concrete for construction at Camp Croft, near Spartanburg, S.C.

ROADS AND STREETS. First Concrete Paving 50 Years Old, T. Bartholomew. *Eng. News-Rec.*, vol. 127, no. 9, Aug. 28, 1941, pp. 297–299. History of construction and survey of present condition of first Portland cement concrete paving in United States, laid in Bellefontaine, Ohio, in 1891, by G. W. Bartholomew; costs of construction and maintenance.

ROOF TRUSSES. New Pre-cast Concrete Roof Truss. *Concrete & Constr. Eng.*, vol. 36, no. 7, July 1941, pp. 298–299. Description of new patented pre-cast type of reinforced concrete roof truss joined by use of steel gusset plates and bolts, bolt holes being provided in concrete members by means of steel tubes during manufacture.

DAMS

CONCRETE GRAVITY, WASHINGTON. Construction Joint Cleaning, D. S. Watter. *Western Construction News*, vol. 16, no. 7, July 1941, pp. 191–194. Details of wet sand-blast method and equipment for cleaning and treatment of surfaces of horizontal construction joints of concrete gravity dams; features of portable sand blast unit used for cleaning of joint of Grand Coulee Dam.

CONCRETE GRAVITY, WASHINGTON. Grand Coulee Dam Nears Completion. *Eng. News-Rec.*, vol. 127, no. 11, Sept. 11, 1941, pp. 365–366. Progress report on construction of Grand Coulee Dam in Washington, including description of spillway designed for flow of 1,000,000 cu ft per sec; installing generating equipment.

EARTH, ARIZONA. Headgate Rock Dam Completed, F. W. Parker. *Western Construction News*, vol. 16, no. 8, Aug. 1941, pp. 237–238. Main features, history, and construction of rolled earth dam on Colorado River, Indian reservation near Parker, Ariz., having maximum height of 70 ft, and length of 1,300 ft, including concrete spillway and 2,000-ft main canal.

EARTH, WASHINGTON. Dam Building Under Canvas. *Eng. News-Rec.*, vol. 127, no. 9, Aug. 28, 1941, pp. 282–284. Report on methods and equipment used in placing earth and rock fill for 425-ft high Mud Mountain Dam in Washington under canvas tent, stretched between canyon walls, to control moisture in material; rate of progress; details of 10-cu yd bucket and its gate-operating mechanisms.

FOUNDATIONS

BRIDGE PIERS, CONSTRUCTION. Skyscraper Piers. *Construction Methods*, vol. 23, no. 7, July 1941, pp. 62–63, 97, and 100. Methods and equipment used in construction of two reinforced concrete piers, 356 and 358 ft high, for Pit River steel truss bridge in California; welding of 2-in. bars.

DESIGN. Design of Footings and Rafts, A. L. L. Baker. *Concrete & Constr. Eng.*, vol. 36, nos. 6 and 8, June 1941, pp. 251–260 and Aug., pp. 339–344. Solution of statically indeterminate frames; example showing use of table in calculating stresses in raft frame subject to diagonal bending; investigation of moments.

DRYDOCKS, EXCAVATION. Navy Drydock Area Drained with Well Points to Eliminate Costly Cofferdam. *Construction Methods*, vol. 23, no. 8, Aug. 1941, pp. 62–63, 105–106, and 108. Construction of cruiser graving dock in San Diego, Calif., by making 400,000-cu yd excavation with system of 1,500 well points and no cofferdam.

EMBANKMENTS, FAILURE. Foundation Failure Causes Slump in Big Dike at Hartford, Conn. *Eng. News-Rec.*, vol. 127, no. 5, July 31, 1941, p. 142. Report on failure of 1,000-ft section of new flood control dike and highway embankment along Connecticut River at Hartford, Conn., which slumped and moved about 50 ft out into river.

EMBANKMENTS, STABILIZATION. Befestigung eines Bahndammes in Moorgebiet bei vollem Betrieb, Koldewitz. *Organ fuer die Fortschritte des Eisenbahnwesens*, vol. 95, no. 19/20, Oct. 19, 1940, pp. 313–319. Methods used in reconstruction and stabilization of slipped railroad embankment in swampy region of Germany, while maintaining train service at reduced speed.

EXCAVATION. Charts for Estimating Hand Trenching Outputs and Costs, J. L. Turner. *Eng. News-Rec.*, vol. 127, no. 5, July 31, 1941, p. 180. Three graphical charts for figuring volume of trenching as function of depth and width, man hours, and costs per cubic yard.

EXPLORATION. Offset Shooting for Foundation Exploration, R. M. Strohl. *Eng. News-Rec.*, vol. 127, no. 3, July 17, 1941, pp. 110–111. Discussion of method of seismograph determination of subsoil conditions by triangular layout of shot and detector positions, enabling layer thicknesses and depths to rock to be determined accurately and economically; path of seismic wave used for calculation of delay times due to overburden; use of common delay time in different shooting layouts; application of method.

EXPLORATION. Subsurface Explorations by City Forces, I. V. A. Huie. *Eng. News-Rec.*, vol. 127, no. 9, Aug. 28, 1941, pp. 294–296. Report on organization and work of foundation exploration service of New York City Department of Public Works; development of improved methods and tools; simplified and uniform method of recording data; local variations in substrata; curve showing relation of boring cost to total cost on 25 projects; advantages derived from work thus far accomplished; future development.

PILE DRIVING. Pile Driving in Clay, R. R. Minikin. *Engineer*, vol. 172, no. 4460, July 4, 1941, pp. 10–12. Discussion of problems involved; sounder methods are direct-bearing tests and hammer-driven test piles; test methods and formulas presented.

SOILS, CLAY. Undisturbed Clay Samples and Undisturbed Clays, K. Terzaghi. *Boston Soc. Civ. Engrs.—J.*, vol. 28, no. 3, July 1941, pp. 211–231. Discussion of assumptions concerning properties of clay which cannot be determined by laboratory tests; writer's conception regarding physical causes of difference between perfectly undisturbed clays and of so-called undisturbed samples; virgin and sedimentation compression curves; solid and lubricated states of clays; consolidation due to increasing load on normally consolidated, sedimentary clay; settlement under small loads. Bibliography.

SOILS, CONSOLIDATION. Chemical Joint Sealing and Soil Solidification, C. M. Riedel. *Eng. News-Rec.*, vol. 127, No. 7, Aug. 14, 1941, pp. 222–225. Report on recent application of Joosten soil consolidation process in sealing leaky cracks in Chicago Freight Tunnel; principles to be observed in its use for soil consolidation; examples of chemical soil solidification as applied to difficult construction operations in Europe; cost of process; limitations on method.

HYDRAULIC ENGINEERING

HYDRAULIC STRUCTURES, LINING. Asphalt Uses in Hydraulics, V. A. Endersby. *Western Construction News*, vol. 16, nos. 7 and 8, July 1941, pp. 197–199 and Aug., pp. 245–248. Use of asphalt on hydraulic structures such as river channels, canals, and dams; nature of asphalt and relationship between its characteristics and features desired in hydraulic structures; asphalt in combination with mineral aggregates; asphaltic concrete; principles of asphaltic construction; mechanical stability; sealing membranes; precast membranes; experiments with coarse, loosely woven cotton cloth, burlap, or paper as reinforcement for thin membranes.

HYDROLOGY AND METEOROLOGY

EARTHQUAKES, CALIFORNIA. Earthquake Risk and Its Abatement in California, H. O. Wood. *Science*, vol. 94, no. 2435, Aug. 29, 1941, pp. 195–200. Greater part of article deals with risk that there is—its geographic spread over region, and what can be done to lessen it; risk from earthquake occurrence in California region, though more general and widespread than most residents realize, is nevertheless much smaller than most non-residents and some local people commonly think.

FLOODS, HYDROGRAPH. Flood Hydrograph, H. M. Turner and A. J. Burdoin. *Boston Soc. Civ. Engrs.—J.*, vol. 28, no. 3, June 1941, pp. 232–256, (discussion) pp. 257–281. Presentation of new original analysis of flood hydrographs; application of method to New England flood records; recession and storage curves; effect of varying elements; comparison with equations for flood hydrograph derived by R. T. Zoch.

SOILS, MOISTURE. Hydraulic Head Measurements in Soils with High Water Tables, R. E. Moore and K. R. Goodwin. *Agric. Eng.*, vol. 22, no. 7, July 1941, pp. 263–264. Description of portable apparatus consisting of soil probe, mechanism to force probe into earth, and device to measure hydraulic head, for obtaining information on hydrology and stratigraphy of unconsolidated soil sediments below water table; application of information to investigations of land and highway drainage, foundations and borrow pits, and domestic or irrigation water supplies.

INLAND WATERWAYS

CANAL LOCKS, CONSTRUCTION. Tower Framing Supports Steel Shells for Tall Concrete Columns. *Construction Methods*, vol. 23, no. 8, Aug. 1941, pp. 52–53, and 113–114. Construction of 26 cast-in-place reinforced-concrete piles, 64 ft high, which support upper guard wall above navigation lock at Pinopolis Dam by using steel pipes for column forms and installing tower bracing between plumb and batter legs in each column group.

RIVERS, IMPROVEMENT. Eindeichung und Abfluss, R. Winkel. *Bautechnik*, vol. 19, no. 24, June 6, 1941, pp. 262–263. Theoretical mathematical discussion of effect of levees on flow of water river channels; numerical examples.

RIVERS, IMPROVEMENT. Upper Mississippi River Project, C. P. Gross and H. G. McCormick. *Military Engr.*, vol. 33, no. 190, July–Aug. 1941, pp. 311–317. Review of U.S. Army engineers project for improvement of Upper Mississippi River; characteristics of Upper Mississippi; history of navigation; 9-ft channel project; canalization by locks and dams; locations of dams; operation of dams; economic aspects of project; its place in national defense.

PORTS AND MARITIME STRUCTURES

BOSTON, MASS. Boston's Port in Defense Picture, R. Parkhurst. *World Ports*, vol. 3, no. 10, July 1941, pp. 6–9 and 17. What port of Boston is doing and can do in way of aiding defense movement; examination of port itself, its facilities, activities, and capabilities.

CORPUS CHRISTI, TEX. Seawall and Waterfront Development Completed at Corpus Christi. *Eng. News-Rec.*, vol. 127, no. 11, Sept. 11, 1941, pp. 346–348. Report on ultimate development of port of Corpus Christi, Tex., including construction on reinforced concrete seawall, 12,000 ft long, with 2,000,000 cu yd of dredged fill behind it and wide boulevard on top of fill, also pleasure piers and yacht basins.

ROADS AND STREETS

AIRPORT RUNWAYS. Omaha's Municipal Airport, F. S. Gilmore. *Aero Digest*, vol. 39, no. 2, Aug. 1941, pp. 67–68, 71, and 227. All runway pavements constructed since 1936 have consisted essentially of three elements: Asphalt surface course, graded soil aggregate base course, and compacted soil sub-base course. Preparation and surfacing of runways described in detail.

AIRPORT RUNWAYS. Speed in Concrete Airport Paving, A. A. Anderson. *Aero Digest*, vol. 39, no. 2, Aug. 1941, pp. 88 and 90. Methods used by contractors, who have been successful in completing runway jobs rapidly, are studied.

BITUMINOUS. Study of Bituminous Concrete Pavements in Ohio. *Pub. Roads*, vol. 22, no. 6, Aug. 1941, pp. 129–142. Investigation of bituminous concrete pavements by Ohio Department of Highways, with special reference to factors affecting service record and current condition; need for softer asphalts in surface courses; results of laboratory tests and correlation with field survey data; effects of mixing on changes in asphalt; aging in pavement; test results correlated with service behavior; relation of surface condition to base condition; effect of aggregate grading.

CONSTRUCTION. Experience in California with Cement-Treated Road Bases, F. N. Hveem. *Eng. News-Rec.*, vol. 127, no. 5, July 31, 1941, p. 175. Abstract of paper before fourth Arizona Roads and Streets Conference analyzing characteristics and costs of California type of pavement base constructed with low cement ratio and compacted mechanically at optimum moisture content.

CRATERING. Rapid Road Cratering. *Military Engr.*, vol. 33, no. 190, July–Aug. 1941, pp. 308–310. Comparative discussion of methods developed by Engineer Board of United States Army for cratering of highways with explosives, for producing effective tank obstacles.

CURVES. Finding Tangent Slopes on Highway Vertical Curves, W. E. Cooper. *Eng. News-Rec.*, vol. 127, no. 11, Sept. 11, 1941, p. 377. Outline of method of calculation of grade or tangent slope at some particular point on vertical curve, based on property of parabolic vertical curve that change in gradient between grade at beginning of curve and any tangent or grade line is directly proportional to horizontal distance between point of tangency in question and beginning of curve.

FLORIDA. Modern Highway Through Florida's Everglades, J. H. Dowling. *Roads & Streets*, vol. 84, no. 8, Aug. 1941, pp. 56, 58, 60, and 64–65. Design and construction of recently completed Will Memorial Highway from South Bay on Lake Okeechobee to Fort Lauderdale and


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Miami, 85 miles long; methods and equipment used for excavating muck from roadway; filling roadway embankment; surfacing.

PANAMA. National Defense Highway No. 1, J. Ewen. *Western Construction News*, vol. 16, no. 7, July 1941, pp. 201–204. Report on construction by Public Roads Administration of Trans-Isthmian highway from Colon to Panama, 47 miles long, considered vital to defense of Panama Canal; design standards; construction problems; drainage structures; organization.

PANAMA. Road Now Being Completed Across Isthmus of Panama. *Roads & Streets*, vol. 84, no. 7, July 1941, pp. 42–44. Methods and equipment used in construction of modern highway, 24 1/2 miles long, across hills and through jungles of Isthmus of Panama, from point near Fort Randolph Road in Canal Zone to Madden Dam; design features; materials and labor.

WIDENING. Six Miles of Pulaski Road Widened and Repaved, M. V. Burton. *Roads & Streets*, vol. 84, no. 7, July 1941, pp. 33–38. Description of methods and equipment used in excavation and other construction work for improvement of one of most important highway arteries of Chicago, Ill.; tabulation of unit prices bid; construction of integral curbs along car tracks.

SEWERAGE AND SEWAGE DISPOSAL

DISPOSAL PLANTS, MILITARY CAMPS. Emergency Sewage Treatment, E. A. Smith. *Eng. News-Rec.*, vol. 127, no. 5, July 31, 1941, pp. 174–175. Use of emergency settling tank and simple chlorinating device to provide sewage disposal facilities for several thousand troops which arrived at Camp Croft, S.C., before construction was completed; sewage characteristics at Camp Croft; sewage flow characteristics.

DISPOSAL PLANTS, WASTE UTILIZATION. Baltimore Will Sell Sewage Effluent for Industrial Water Supply Uses. *Eng. News-Rec.*, vol. 127, no. 3, July 17, 1941, p. 73. Information on contract for delivery of 40 mgd of treated sewage effluent from Baltimore disposal works to serve as part of industrial water supply for Bethlehem Steel Company plant at Sparrows Point, Md.

STRUCTURAL ENGINEERING

ANTI-AIRCRAFT PROTECTION. Factors in Aerial Bombardment Protection, H. E. Wessman and W. A. Rose. *Eng. News-Rec.*, vol. 127, no. 9, Aug. 28, 1941, pp. 300–304. Discussion of forces of bomb impact and explosion; static-load and energy methods of designing structural members to withstand bombing; methods of protection against fragmentation, blast, and suction; provisions for safety zones in existing buildings; thicknesses of materials to protect against bomb fragments; wall panels to resist blast; possible direct hits on skyscraper during aerial bombardment.

ANTI-AIRCRAFT PROTECTION. Structural Problems in Bomb Protection, H. E. Wessman and W. A. Rose. *Eng. News-Rec.*, vol. 127, no. 11, Sept. 11, 1941, pp. 349–352. Article discussing most suitable exterior wall construction for buildings to provide protection against bombs; most favorable design of interior walls, partitions, floor systems, and stairways; problems of designing bomb-resistant shelters, including sanitary and ventilation requirements; recommended practices for shelters; design of shelter for 1,200 persons, etc.

ARCHES, DESIGN. Two-Hinged Rectangular Arch Having Variable Moment of Inertia, C. A. Ellis. *Purdue Univ. Eng. Experiment Station—Research Series*, no. 79, vol. 25, no. 1a, Feb. 1941, 53 pp. Equations and solutions given, one for each condition of loading, which will solve corner bending moment in any two hinged rectangular reinforced concrete arch having uniform variation of width in posts and parabolic variation in deck.

BEAMS, CONCRETE. Construction Design Chart—LXVII—Area of Steel for T-Beams, J. R. Griffith. *Western Construction News*, vol. 16, no. 7, July 1941, p. 209. Presentation of alinement chart for computing area of steel reinforcement for concrete T-beams; numerical example.

BEAMS, CONCRETE. Influence of Shear Cracks on Bond Slip in Reinforced Concrete Beams, R. H. Evans. *Structural Engr.*, vol. 19, no. 7, July 1941, pp. 119–125. Report on experimental study for determination of: stress distribution on vertical sections after failing load in shear or diagonal tension has been almost reached, and influence of vertical stirrups, inclined stirrups, and bent-up rods on maintenance of bond or adhesion between tension reinforcement and concrete.

BEAMS, CONCRETE. Tests of Reinforced Concrete Beams with Recommendations for Attaining Balanced Design, K. C. Cox. *Am. Concrete Inst.—J.*, vol. 13, no. 1, Sept. 1941, pp. 65–80. Recommendations for obtaining balanced design of reinforced concrete beams on basis of results of tests of 110 rectangular beams of 4 concrete strengths and 23 percentages of reinforcement; experimental determination of maximum amount of steel that can be fully utilized for any concrete strength; data on doubly-reinforced beams and beams of variable effective depth; load-deflection curves. Bibliography.

BEAMS, CONTINUOUS. Der durchlaufende Traeger mit Gelenken (Bauart Breest), G. Worch. *Bautechnik*, vol. 19, no. 23, May 30, 1941, pp. 247–251. Theoretical mathematical discussion of design of hinged continuous girders of Breest system, including cases of girders continuous over very many supports; numerical examples.

BEAMS, WOODEN. Construction Design Chart—LXIX—Properties of Timber Beams, J. R. Griffith. *Western Construction News*, vol. 16, no. 9, Sept. 1941, p. 274. Alinement giving structural properties of rough and dressed timber beams; numerical examples.

FRAMED STRUCTURES, DESIGN. Design of Welded Rigid Frames, V. A. Murphy. *New Zealand Instn. Engrs.—Bul. & Proc.*, vol. 27, no. 1, Apr. 15, 1941, pp. 86–134, supp. plates. Structural characteristics of continuous frames; methods of analysis of rigid or continuous frames by mathematical analysis and by mechanical experiment on small-scale models; use of special graphs for direct design of single bay bents; original researches conducted on welded knee joints. Bibliography.

FRAMED STRUCTURES, WELDED STEEL. New Rigid-Frame Building Uses Butt-Welded Field Splices, L. Grover. *Steel*, vol. 109, no. 6, Aug. 11, 1941, pp. 80 and 84. How to use butt-welded field splices, even in members subject to dynamic loading, is revealed; description of practice employed in recent rigid-frame building.

LIGHT-WEIGHT CONSTRUCTION. Leichtbauweise, R. Ulbricht. *Stahl u Eisen*, vol. 61, no. 14, Apr. 3, 1941, pp. 350–353. Present status of light-weight construction; illustrated description based on literature of past few years; among means discussed of achieving light-weight construction are use of lighter materials, welding in place of riveting, and use of tubular or shell construction for increasing bearing load.

ROOF TRUSSES, CONCRETE. New Pre-Cast Concrete Roof Truss. *Concrete & Constr. Eng.*, vol. 36, no. 7, July 1941, pp. 298–299. Description of new patented pre-cast type of reinforced concrete roof truss joined by use of steel gusset plates and bolts, bolt holes being provided in concrete members by means of steel tubes during manufacture.

ROOFING MATERIALS, ASBESTOS CEMENT. Asbestos-Cement Tubes in Roof Construction. *Concrete & Constr. Eng.*, vol. 36, no. 8, Aug. 1941, pp. 345–347. Features of truss roofs built with asbestos-cement tubes and sheets and concrete connections.

STRUCTURAL DESIGN. Few Moot Questions in Structural Design and Analysis, O. G. Julian. *Boston Soc. Civ. Engrs.—J.*, vol. 28, no. 3, July

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1941, pp. 282–296. Discussion of fundamental principles of theory of structural design.

TRAFFIC CONTROL

RAILROAD CROSSINGS, GRADE SEPARATION. Accident Hazard at Grade Crossings, L. E. Peabody and T. B. Dimmick. *Pub. Roads*, vol. 22, no. 6, Aug. 1941, pp. 123–128 and 142–144. Discussion of methods of measuring need for highway-railroad grade crossing separation or protection; ratings based on hazard to life and time loss; protection coefficients calculated for various types of crossing protection; probable number of accidents in 5 years used as index of hazard; relation between highway traffic and accidents, also railroad traffic and accidents; accident probability factors; Maryland crossings rated according to relative hazard; formulas.

TUNNELS

CONSTRUCTION. Some Notes on Tunneling Practice, R. Hammond. *Engineer*, vol. 172, no. 4465, Aug. 8, 1941, pp. 83–86. Three main factors discussed in tunneling through rock; efficient and economical use of explosives; length and disposition of shot holes suitable for any particular ground, and rapid removal of shattered rock; each tunneling problem will have to be studied on its merits, so much depending upon local conditions.

RAILROAD, FLAME CLEANING. Flame Cleaning Removes Paint from Concrete Tunnel. *Ry. Eng. & Maintenance*, vol. 37, no. 10, Oct. 1941, pp. 683–684. Article describes how Erie, employing this method in passenger tunnel at Jersey City, N.J., to remove heavy accumulation of badly deteriorated paint, found it highly effective, without causing any damage whatever to surface of underlying concrete.

SEWER CONSTRUCTION. Siphon Sewer Built Under Difficulties, T. A. Berrigan. *Eng. News-Rec.*, vol. 127, no. 9, Aug. 28, 1941, pp. 305–307. Installation of three-tube siphon for Boston metropolitan sewer system involving lowering of existing siphon, with which was incorporated construction of two additional 60-in. conduits; construction of open cut and tunnels; shield operation; total cost was $1,000,000.

VENTILATION. Methods of Ventilating Vehicular Tunnels, F. F. Kravath. *Heat & Vent.*, vol. 38, no. 9, Sept. 1941, pp. 53–57. Methods of ventilation are discussed as follows: simple pressure type; pressure duct type; simple exhaust type; exhaust duct type; compound system.

VENTILATION. New Jersey Ventilation Building. *Port of New York Authority—Contract MHT-58*, Oct. 1941, 127 pp. Information for bidders and specifications for construction of New Jersey Ventilation Building for north tube of Lincoln tunnel; substructure extends to depth of 60 ft below ground surface; superstructure will be about 100 ft, 65 ft in plan, rising 145 ft above ground.

WATER SUPPLY, NEW YORK. Construction of Delaware Aqueduct, R. W. Armstrong. *New England Water Works Assn.—J.*, vol. 55, no. 2, June 1941, pp. 135–154, (discussion) 154–165, supp. plates. Description of Delaware water system and Delaware aqueduct; data relating to shafts and tunnel contracts for Delaware aqueduct; shaft construction; construction of tunnel and tunnel lining.

WATER SUPPLY, NEW YORK. Passing Faults on Delaware Aqueduct. *Eng. News-Rec.*, vol. 127, no. 5, July 31, 1941, pp. 150–154. Methods used in successfully passing fault zones encountered at several points along Delaware water supply tunnels, 85 miles long, for New York City water works.

WATER PIPE LINES

AQUEDUCTS, COLORADO RIVER. Colorado River Aqueduct. *Western Construction News*, vol. 16, no. 8, Aug. 1941, pp. 221–236. Statistical data on and general description of Colorado River aqueduct, including main features of Parker Dam, water supply tunnels, pumping plants and siphons, canals, and conduits, also distribution systems. Bibliography.

DISINFECTION. Sterilisation of Small Water Mains. *Water & Water Eng.*, vol. 43, no. 544, Sept. 1941, pp. 264–266. Disadvantages of disinfection of water mains with sodium hypochloride solution; methods and apparatus used by Halifax Corporation, England, for disinfection of mains with chlorine solution.

WATER RESOURCES

CALIFORNIA. Report of Sacramento-San Joaquin Water Supervision for Year 1940. *Calif. Dept. Pub. Works—Report*, June 1941, 187 pp. Record of investigations, river discharge; measurements of diversions; measurements of return water; use of water in Sacramento-San Joaquin Delta; annual census of irrigated crop acreages and water consuming areas; salinity investigations; area of salinity encroachment; tide gages.

WATER TREATMENT

ARGENTINA. Modernizacion del Establecimiento de Potabilizacion de Agua de la Ciudad de Corrientes, C. Santos Rossell. *Boletin de Obras Sanitarias de la Nacion*, vol. 5, no. 46, Apr. 1941, pp. 389–401. Modernization of water treatment plant of city of Corrientes, in Province of Corrientes, Argentina; work is intended to perfect process of treatment of water from Parana River, comprising injection and diffusion of chemical substances, flocculation, and decantation.

FILTRATION PLANTS, CAMBRIDGE, MASS. Operation of Cambridge, Mass., Filtration Plant, F. E. Smith. *New England Water Works Assn.—J.*, vol. 55, no. 2, June 1941, pp. 254–264. Review of water operating experiences, since 1930, of 22-mgd water filtration plant of Cambridge, Mass.; quality of raw water; copper sulfate treatment; coagulation; alum equipment; filters; treatment of sand; filter breaking; filter washing; disposal of used wash water; chlorination; quality of plant effluent; cost of operation.

GROTON, CONN. Water Treatment at Groton, Connecticut, A. N. Tiffany and A. L. Shaw. *New England Water Works Assn.—J.*, vol. 55, no. 2, June 1941, pp. 233–253. Description of new 2-mgd water treatment plant of Groton, Conn.; raw-water pumping; aeration and chemical mixing; chemical feeders; sedimentation; filtration; high-lift pumping; electric power system; emergency power; construction cost; use of chemicals; corrosion control; cost of operation.

NEW YORK. Sanitation and Purification of New York City's Water Supplies, F. E. Hale. *New England Water Works Assn.—J.*, vol. 55, no. 1, Mar. 1941, pp. 62–82. Survey of various methods by which New York City's water supply is safeguarded; work of Watershed Division and of Laboratory Division; effect of storage at Ashokan Reservoir; quality of water in Kensico Reservoir at various depths; sewage disposal; chlorination; removal of turbidity; iron removal; microscopic organisms.

WATER BACTERIOLOGY. Bacteriological and Field Studies of Water Distribution Systems, W. J. Scott. *New England Water Works Assn.—J.*, vol. 55, no. 1, Mar. 1941, pp. 83–108, (discussion) 108–114. Report on study by Connecticut State Department of Health of sanitary conditions in water distribution systems for investigation of causes of discrepancy in bacteriological results of samples collected near points of water treatment on public water supplies and samples obtained at various points throughout distribution system; bacteriological research studies.

WATER WORKS ENGINEERING

ARGENTINA. Las Obras de Provision de Agua Potable a General Alvear y Pueblo Luna, E. F. E. Gaggino. *Boletin de Obras Sanitarias de la Nacion*, vol. 5, no. 44, Feb. 1941, pp. 116–126. Water works for supply of potable water to General Alvear and Pueblo Luna, in Province of Mendoza, Argentina; historical note; Atuel River selected as source of supply; cast iron intake pipe 0.250 m in diameter; pumps; settling tanks and filters; chlorination; distribution tank and distributing mains; treatment and total costs.

ARGENTINA. Provision de Agua a La Ciudad de Rafaela, O. J. P. Torti and U. Maini Cuneo. *Boletin de Obras Sanitarias de la Nacion*, vol. 5, no. 45, Mar. 1941, pp. 230–242. Water supply of City of Rafaela, in Province of Santa Fe, Argentina; 4 semi-artesian wells at about 29 m depth, yielding about 10 to 16 cu m per hour per well; pumps; distributing tank; supply mains; distribution lines and service connections; treatment plant, installed in 1939, uses mixed solution of calcium hypochlorite and sodium carbonate; population of 3,315 served; to reach 13,200 when all installations are completed.

ARGENTINA. Proyecto de Provision de Agua a la Ciudad de Tres Arroyos, A. E. Guerra Bruche. *Boletin de Obras Sanitarias de la Nacion*, vol. 5, no. 49, July 1941, pp. 50–57. Project of supplying water to city of Tres Arroyos, in Province of Buenos Aires, Argentina; historical outline; project involves boring of 6 semi-artesian wells, 5 being considered capable of supplying present population of 18,000 inhabitants; centrifugal pump; distribution tank and network; service connections; cost estimate.

BOSTON, MASS. Swift and Ware Rivers Ready to Serve Boston, K. R. Kennison. *Water Works Eng.*, vol. 94, no. 19, Sept. 10, 1941, pp. 1124–1127 and 1177–1178. History and description of new supplementary 210-mgd water supply for Metropolitan District Water Supply Commission of Boston, Mass.; delivery of supply through pressure aqueduct reducing pumping costs; Quabbin Reservoir; Quabbin Aqueduct; extension now under way; enlargement of Fells Reservoir.

CINCINNATI, OHIO. Water Supply at Cincinnati. *Am. Water Works Assn.—J.*, vol. 33, no. 7, July 1941, pp. 1198–1217. Symposium by staff members on features and operation of water works of Cincinnati, Ohio, including following: Introduction, C. A. Eberling; Pumping Plants, R. E. Duhme; New Filtration Plant, C. Bahlman; Distribution System, W. Sahnd; Distribution System Maintenance, J. H. Rimmer; Commercial Division, M. F. Hoffman; Legal Phases, E. F. Alexander.

STOUGHTON, MASS. Development of Stoughton's Water Collecting System, L. Morrill. *New England Water Works Assn.—J.*, vol. 55, no. 2, June 1941, pp. 206–215. Construction of water collecting system for development of spring water supply for Stoughton, Mass., to serve population of 10,000.

DEFENSE
won't wait for weather!

• Under a scorching sun this "Caterpillar" Diesel No. 12 Motor Grader windrows dirt for airport construction at Felton Field, Pensacola, Florida. Dual engine cooling keeps both water and oil at the proper temperature.

In the first nine months of 1941 the men and machines of America's earth-moving industry have dug, scraped, hauled and bull-dozed more than 800,000,000 cubic yards of dirt and rock — all on defense work!

The fact that much of this immense yardage has been handled under the toughest kind of conditions is a tribute to the rugged power, traction and stamina of "Caterpillar" Diesel Tractors and Motor Graders. These sturdy machines ask no favors of terrain or weather. In soft mud, on sun-baked clay or frozen ground, they come out slugging, right from the bell.

• At the U. S. Army Proving Grounds, Aberdeen, Maryland, a "Caterpillar" Diesel D7 Tractor with LaPlant-Choate bulldozer works in heavy March mud.

The broad steel tracks of a "Caterpillar" Diesel Tractor furnish solid footing for its tremendous engine power, and the final drive is protected from mud, water and grit by copper bellows-seals. Balancing engine weight over the drive wheels gives a "Caterpillar" Diesel Motor Grader its unbeatable tractive power. Both machines start fast and run smoothly whether the temperature is zero or 100. And both operate with better-than-average Diesel economy because they use the cheaper grades of fuel.

Most important of all, *they're built to stand up under punishment* day and night, month after month, with a minimum of lost time.

Every minute counts in the present emergency, and "Caterpillar" dependability has a vital part in licking America's biggest job.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

CATERPILLAR
REG. U.S. PAT. OFF.

DIESEL

ENGINES AND ELECTRIC SETS
TRACK-TYPE TRACTORS • ROAD MACHINERY

Equipment, Materials, and Methods

New Developments of Interest, as Reported by Manufacturers

Air-Controlled Shovel

THE NEWLY DEVELOPED Osgood Type 70 excavator and material handler is available with either conventional crawler mounting, or as a Mobilcrane with pneumatic tired wheel mounting. It is rated as a $1^1/_4$ cu yd shovel or a 15 ton crane.

Special features claimed for the Type 70 are: Unit cast steel construction of deck, for fewer parts and less vibration; air control, for saving wear and tear on operating machinery and operator; twin disc clutches, for smoothness of operation and the ability to handle heavy loads; steering in any direction without stopping the forward motion of the machine; independent travel mechanism for crane service; independent boom hoist if required; roomier, streamlined cab; all controls banked in front of and around the operator, with air levers providing opportunity for precision and lessening fatigue; upper body centered on revolving base; lifting strains on vertical travel shaft relieved by hook rollers.

For additional information and specifications, write Osgood Co., Marion, Ohio.

Ozone Water Purifier

A COMPLETELY AUTOMATIC, self-contained purification plant has been developed by the Technicraft Engineering Co., 5610 South Soto St., Los Angeles, Calif. The unit, known as the "Sterozone," was designed for use in army camps and for use of troops on maneuvers, but is said to have wide industrial and municipal applications.

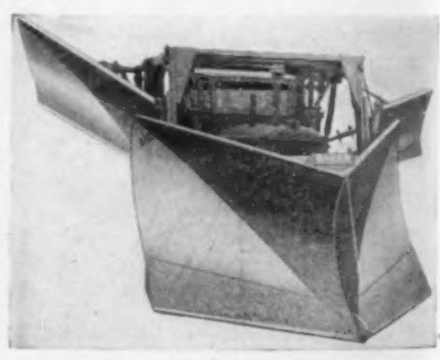
The Sterozone unit has a rated capacity up to 9000 gal per hr, and automatic parallel operation of units can be made to supply larger requirements. Raw water is pumped from the source through a filter to remove suspended matter and then passed to an absorber chamber where ozone, generated by a high frequency silent electric discharge oxidizes the bacterial contamination. It is claimed that water so treated has no taste or odor. Since the sterilizing agent is ozone gas, generated

within the unit itself, no supplies of gas or chemicals are required. Power is supplied from an automatic gasoline-engine driven 10 KVA, 220 V, 3-phase power plant; all mechanism is driven by a 5 hp, 200 V, 3-phase electric motor.

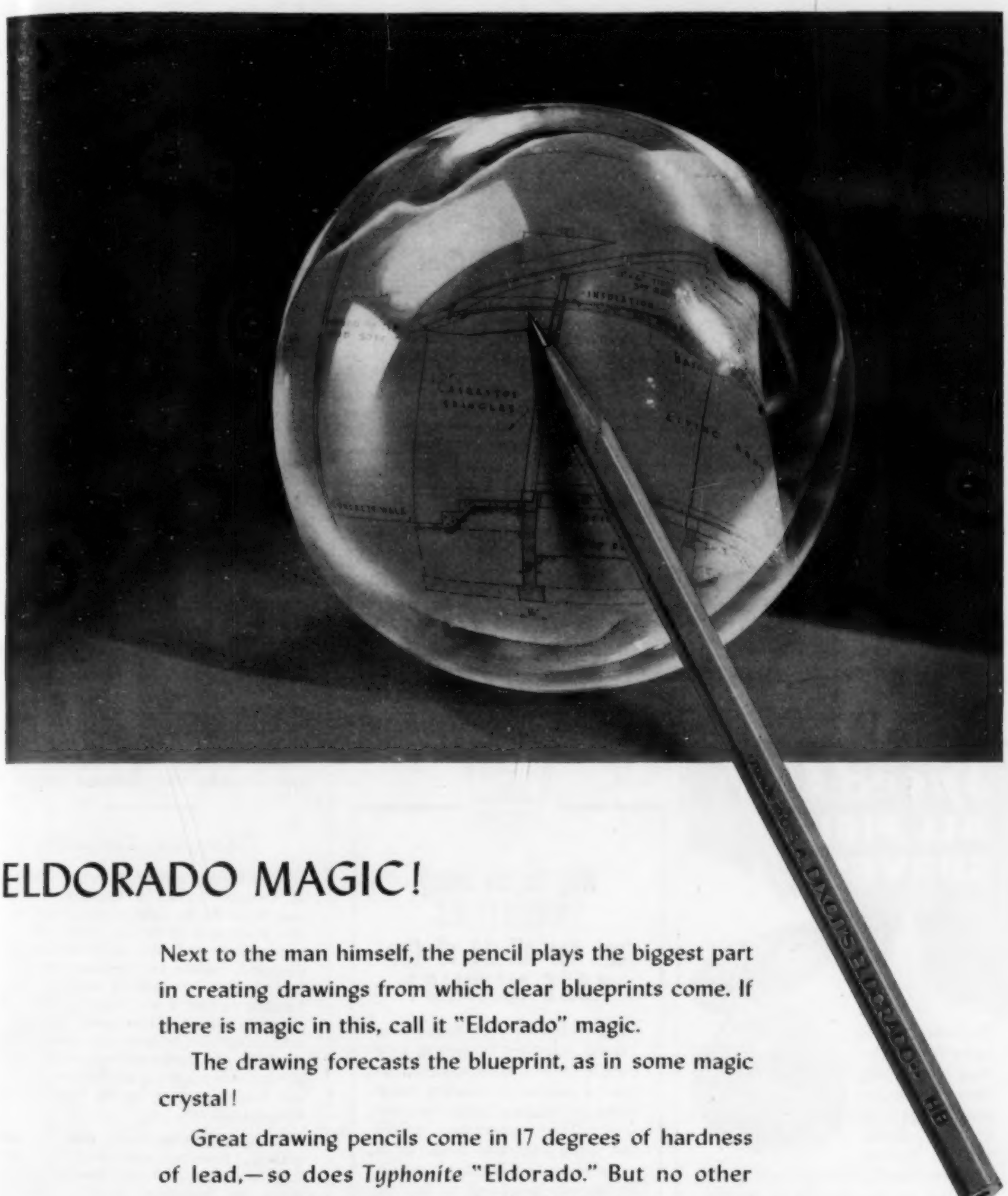
Snow Plows

THE ADDITION OF A LINE of "V" and side wing snow plows, to be known as the 300 and 400 Series, is announced by The Baker Mfg. Co., Springfield, Ill.

Made for use with all models of Allis-Chalmers Tractors, these snow fighters feature independent hydraulic side wing control. By means of two hydraulic cylinders for each wing, positive independent wing operation is provided; front, rear, or both ends of wings can be raised, lowered, or folded tight against the tractor. The high "V" plow hugs the front of



the tractor and is hydraulically controlled with a four-way valve for raising, powering, floating, or forcing the blade down to cut ice or packed snow. It is claimed that the flexible operation of these plows, plus independent side wing control, accomplishes faster, cleaner snow removal on high drifts and ice-encrusted packed snow, and that average to heavy snowfalls can be handled at top tractor speeds. Descriptive bulletins are available.



ELDORADO MAGIC!

Next to the man himself, the pencil plays the biggest part in creating drawings from which clear blueprints come. If there is magic in this, call it "Eldorado" magic.

The drawing forecasts the blueprint, as in some magic crystal!

Great drawing pencils come in 17 degrees of hardness of lead,—so does *Typhonite* "Eldorado." But no other drawing pencil has *Typhonite* leads. *Typhonite* is created in a literal whirlwind from natural graphite. There is no stopping the whirlwind and there is no stopping Dixon *Typhonite* "Eldorado" as it whirls along far in the lead.

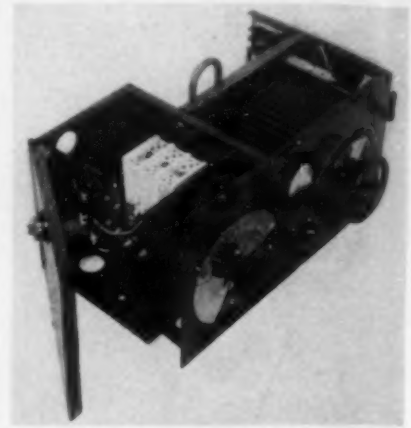
TYPHONITE
ELDORADO

PENCIL SALES DEPARTMENT 38-J12 · JOSEPH DIXON CRUCIBLE CO. · JERSEY CITY, N. J.

Arc Welder Control Box

FURTHER IMPROVEMENT in Dual Continuous Control for arc welding machines, is a new welder control box announced by the Lincoln Electric Company, Cleveland, Ohio.

Enhancing the benefits of Dual Continuous Control, the new box, designated "Type G," prevents accidental contact with live parts, increases accessibility, permits wiring with flexible or rigid conduit, or rubber-covered multiple-conductor cable, and eliminates dangers from unintentional loosening of the lifting hook.



An important feature of the new box is the fact that there is a separate compartment for all a-c circuits, including push button, and another separate one for d-c terminals. An additional feature is a new lead clamp which prevents the bending or damage to output studs when the welder leads are accidentally jerked or pulled.

Literature Available

"AIR REDUCTION—A Quarter Century of Progress" gives a detailed description of the five companies which comprise Air Reduction Company, Inc. Its 54 pages, illustrated both with pictures and diagrams, explain the methods, the markets, and such important aspects of its business as that it is a major producer of oxygen, nitrogen, hydrogen, acetylene, calcium carbide, helium, neon, arc welding machines and equipment—many of which products are playing a vital part in numerous industries now in the forefront of national defense.

SAFETY EQUIPMENT—A new 111-page catalog, covering complete protection from head to ankles, and describing such items as industrial goggles, Calobar lenses, Super Armorplate lenses, welding lenses, welding plates, welding helmets and hand shields, safety clothing, respirators, first-aid kits, etc., with an eye-protection guide and table for choice of the proper shade of glare-protection glass, has just been published by American Optical Co., Southbridge, Mass.

STEEL FORMS—Catalog No. 1836, contains sixty pages, profusely illustrated, on the use of steel forms for concrete pouring. Blaw-Knox Div. of Blaw-Knox Co., Pittsburgh, Penna.

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